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COMPILATION OF ABSTRACTS OF THESES SUBMITTED BY CANDIDATES FOR DEGREES OCTOBER 1991 TO SEPTEMBER 1992

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REPORT DOCUMENTATION PAGE

Form Approved
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Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
		Summary 10/1/91 to 9/30/92

4. TITLE AND SUBTITLE
COMPILATION OF ABSTRACTS OF THESES SUBMITTED BY CANDIDATES FOR DEGREES

5. FUNDING NUMBERS

6. AUTHOR(S)
Students of the Naval Postgraduate School/Candidates for degrees

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5019

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this report are those of the authors and do not reflect the official policy or position of DoD or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This publication contains the abstracts of theses submitted during the period 1 October 1991 - 30 September 1992 by candidates for Doctoral, Master's and Engineer's degrees at the Naval Postgraduate School, Monterey, CA 93943-5000.

14. SUBJECT TERMS

15. NUMBER OF PAGES
467

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std 239-18

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TABLE OF CONTENTS

ADVANCED DEGREES

DOCTOR OF PHILOSOPHY		PAGE
James Michael Clifton Lieutenant Commander, U.S. Navy	Modeling and Control of a Trailing Wire Antenna Towed by an Orbiting Aircraft	3
Shahar Dror Lientenant Commander, Israeli Navy	Identification and Control of Non-Linear Time-Varying Dynamical Systems Using Artificial Neural Networks	3
Peter Staples Guest Meteorologist, Naval Postgraduate School	A Numerical, Analytical and Observational Study of the Effect of Clouds on Surface Wind and Wind Stress during the Central Arctic Winter	4
Eugene Joseph Guglielmo	Intelligent Information Retrieval for a Multimedia Database Using Captions	4
Gilberto Ferreira Mota Commander, Brazilian Navy	Radar Data Processing Using a Distributed Computational System	5
Robert A. Steigerwald Captain, U.S. Air Force	Reusable Software Component Retrieval via Normalized Algebraic Specifications	5
Steven Michael Ziola	Source Location in Thin Plates using Cross-Correlation	6
AERONAUTICAL ENGINEER		
Dennis J.S.R. Bertrand Captain, Canadian Army	Application of Neural Network to Adaptive Control Theory for Super-Augmented Aircraft	9
Jeffrey Dow Clarkson Lieutenant, U.S. Navy	A Computational Investigation of Airfoil Stall Flutter	9
Robert Gordon Graham Lieutenant Commander, U.S. Navy	Implementation of a Personal Computer Based Parameter Estimation Program	10
Stephen A. Modzelewski Lieutenant, U.S. Navy	Computer Program for Calculating In-Flight Aircraft-Store Interface Reaction Loads	10
Kerry S. Neace Lieutenant, U.S. Navy	A Computational and Experimental Investigation of the Propulsive and Lifting Characteristics of Oscillating Airfoils and Airfoil Combinations in Incompressible Flow	11

Joseph W. Rixey **Lieutenant, U.S. Navy**	**A Multi-Faceted Engineering Study of Aerodynamic Errors of the Service Aircraft Instrumentation Package (SAIP)**	**11**

AERONAUTICAL AND ASTRONAUTICAL ENGINEER

Mark A. Brynestad **Lieutenant Commander, U.S. Navy**	**Investigation of the Flight Control Requirements of a Half-Scale Ducted Fan Unmanned Aerial Vehicle**	**15**
Jeffrey Arlen Hailey **Lieutenant, U.S. Navy**	**Experimental Verification of Attitude Control for Flexible Spacecraft Slew Maneuvers**	**15**
Lisa M. Nowak **Lieutenant, U.S. Navy**	**Computational Investigations of a NACA 0012 Airfoil in Low Reynolds Number Flows**	**16**
Dennis R. Sorensen **Lieutenant Commander, U.S. Navy**	**Design and Control of a Space Based Two Link Manipulator W/Lyapunov Based Control Laws**	**16**
David Paul Wood **Lieutenant, U.S. Navy**	**Design of a Microprocessor-Based Control System for the Monterey Institute for Research in Astronomy 36" Telescope**	**17**
Steven Roland Wright **Lieutenant, U.S. Navy**	**A Wing Rock Model for the F-14A Aircraft**	**17**

ELECTRICAL ENGINEER

James Thomas Moore **Lieutenant, U.S. Coast Guard**	**A Mixed Excitation Vocoder with Fuzzy Logic Classifier**	**21**

MASTER OF SCIENCE DEGREES

AERONAUTICAL ENGINEERING

Denis J.S.R. Bertrand Captain, Canadian Army	Application of Neural Network to Adaptive Control Theory for Super-Augmented Aircraft	25
George Scott Brown Lieutenant Commander, U.S. Navy	Exploring Plasma Sheath Solutions for Planar and Cylindrical Anodes	25
Carl Wesley Dane	Exploratory Experimental Investigation of a Wave Propeller	26
Sally deGozzaldi Lieutenant, U.S. Navy	Statistical Fatigue Analysis of the SH-60B Servo Beam Rail Component	26
Brian B. Elliott Lieutenant, U.S. Navy	Flexural Wave Propagation in Anisotropic Laminates and Inversion Algorithms to Recover Elastic Constants Using Phase Velocity Measurements	27
Thomas Flatley Lieutenant, U.S. Navy	Real-Time Detection of Fatigue Cracks at Multiple Holes in 7075 Aluminum Using Acoustic Emission	27
Michael James Gallagher Lieutenant Commander, U.S. Navy	Development of Telemetry for the Agility Flight Test of a Radio Controlled Fighter Model	28
Richard Kirk Joyce Lieutenant, U.S. Navy	A Method of Testing Two-Dimensional Airfoils	28
Paul A. Koch Lieutenant, U.S. Navy	Flight Testing of a Half-Scaled Remotely Piloted Vehicle	28
Gregory Anderson Kress Lieutenant, U.S. Navy	Preliminary Development of a VTOL Unmanned Air Vehicle for the Close-Range Mission	29
Feng-Hsi Li Commander, ROC Navy	Static and Dynamic Flow Visualization Studies of Two double-Delta Wing Models at High Angles of Attack	29
Da-Ming Liu Lieutenant Commander, Roc Navy	Effect of Canard Oscillations on the Vortical Flowfield of a X-31A-Like Fighter Aircraft Model	30
Dennis A. Lott	Analysis of In-Flight Structural Failures of P-3C Wing Leading Edge Segments	30
Russell P. Luehrsen Lieutenant, U.S. Navy	Solid Fuel Ramjet Infrared Signature	30
John Francis O'Leary Captain, U.S. Marine Corps	Flowfield Study of a Close-Coupled Canard Configuration	31

Robert Michael Palatka **Lieutenant, U.S. Coast Guard**	**Numerical Analysis of the Flow in a Turbulated Rectangular Duct Simulating the Cooling Passages in a Turbine Blade**	**31**
Kevin M. Ransford	**Baseline Vibration Measurements of Remotely Piloted Helicopters for Higher Harmonic Control Research**	**32**
Aharon Salama **Major, Israeli Air Force**	**Two-Dimensional Boundary Surfaces for Planar External Transonic Flows**	**32**
Dean C. Schmidt **Lieutenant, U.S. Navy**	**Lift Enhancement Using a Close-Coupled Oscillating Canard**	**33**
Christopher Cyril Sullivan **Captain, U.S. Army**	**An Investigation of a Prototype OASYS' Effectiveness in Maneuvering Flight**	**33**
William Timothy Trainer	**Experimental and Analytical Investigation of the Vibration Characteristics of a Remotely Piloted Helicopter**	**34**
James L. Vandiver **Lieutenant, U.S. Navy**	**RPH Preliminary Design, Trend Analysis and Initial Analysis of the NPS Hummingbird**	**34**
Richard William Walter, II **Lieutenant, U.S. Navy**	**Study of Statistical Variations of Load Spectra and Material Properties on Aircraft Fatigue Life**	**35**
Chun-Wei Wang **Lieutenant, ROC Navy**	**Prediction of Turbine Cascade Flows with a Quasi-Three-Dimensional Rotor Viscous Code and the Extension of the Algebraic Turbulence Model**	**35**
Richard A. Wendland **Lieutenant Commander, U.S. Navy**	**Upgrade and Extension of the Data Acquisition System for Propulsion and Gas Dynamics Laboratories**	**35**
James Griffin Willson **Lieutenant, U.S. Navy**	**Quantitative Force Measurements of Pneumatic Control on a Wing/Strake Model**	**36**
Jen-Cheng Yang **Lieutenant Commander** **ROC Navy**	**IR Imaging for Combustion Characteristics and Optical Properties of Boron/Boron Oxide**	**36**

ASTRONAUTICAL ENGINEERING

William J. Angus **Lieutenant, U.S. Navy**	**An Investigation into the Performance Characteristics of a Solid Fuel Scramjet Propulsion Device**	**39**
Craig Wesley Baldwin **Lieutenant Commander, U.S. Navy**	**Cluster Model of Polarization upon Reflection from Metallic Surfaces**	**39**
Walter J. Bell **Lieutenant, U.S. Navy**	**Proposed Model of Thermionically Assisted Breakdown and Implementation on Electrostatic Thrusters**	**40**

Nigel Ian Gardener Lieutenant Commander, U.S. Navy	Probabilistic Strength-Life Model for Graphite Fibers Under Stress	40
William Lawrence Golden, Jr. Lieutenant, U.S. Navy	Static Pressure Measurements of the Shock-Boundary Layer Interaction in a Simulated Fan Passage	40
Evan Scott Jones Lieutenant, U.S. Navy	Development of an Active Damping System to Aid in the Attitude Control of Flexible Spacecraft	41
David Lee Lashbrook Lieutenant Commander, U.S. Navy	Computer-Based Satellite Design	41
David Terrence Moroney Lieutenant Commander, U.S. Navy	Use of an Optical Multichannel Analyzer for Reflectivity Measurements	42
David D. Pauls Lieutenant, U.S. Navy	Orbital Maintenance of Endoatmospheric Low Earth-Orbiting Satellites	42
John Alan Racine Lieutenant, U.S. Navy	Subscale Solid Rocket Motor Infrared Signature and Particle Behavior	43
Thane Damian Rivers Lieutenant, U.S. Navy	Development of an Automated Scanning Monochromator for Sensitivity Calibration of the MUSTANG Instrument	43
Daniel June Sakoda	Structural Design, Analysis, and Modal Testing of the Petite Amateur Navy Satellite (PANSAT)	43
Thomas P. Spriesterrbach Lieutenant, U.S. Navy	Performance Analysis of Non-Coplanar Synergetic Maneuvers	44
Robert George Vaughan Lieutenant, U.S. Navy	Sensitivity of Sensors for Characterizing Chaos	44
Curtis D. Whisman Lieutenant, U.S. Navy	Emissivity of Rocket Plume Particulates	45

APPLIED MATHEMATICS

Pamela K. Bell Lieutenant, U.S. Navy	A Graph Theoretic Approach to the Optimal Slot Utilization Problem for Naval Communication Networks	49
Kevin J. Cavanaugh Lieutenant Commander, U.S. Coast Guard	A Multilevel Approach to Minimal Cost Network Flows	49
Jonathan Edward Hartman Captain, U.S. Marine Corps	Hypercube Solutions for Conjugate Directions	50
Hugh Joseph McBride Lieutenant, U.S. Naval Reserve	Wave Propagation in Elastic Solids	50

Warren Edward Phipps, Jr. **Captain, U.S. Army**	**Parallelization of the Naval Space Surveillance Center (NAVSPASUR) Satellite Motion Model**	**51**
William H. Thomas, II **Lieutenant, U.S. Navy**	**Introduction to Real Orthogonal Polynomials**	**51**

APPLIED SCIENCE

Carl Andrew Carpenter **Lieutenant Commander, U.S. Navy**	**Mathematical Model and Computer Algorithm for Tracking Coastal Storm Cells for Short-Term Tactical Forecasts**	**55**
Philip Walter Criswell, Jr **Lieutenant, U.S. Navy**	**An Evaluation of the ASSET Campaign Model in a Regional Antisubmarine Warfare Context**	**55**
Gary Emery English **Lieutenant, U.S. Navy**	**Sensitivity of the Tomographic Inverse Solution to Acoustic Path Variability**	**56**
Alan Kulp Jenkins	**Modeling Convergence Zone Gain on MS-DOS Based Personal Computers**	**56**
Thomas K. Kisiel **Lieutenant, U.S. Navy**	**Study of Plane Wave Impingement on a Thin Plate Capable of Deformation**	**56**
Debra M. Livingood **Lieutenant, U.S. Navy**	**Extension of the Analytical Approximation to the Transmission of Sound in Shallow Water Using the Image Model**	**57**
Claude F. Martin, III	**An Evaluation of Open Ocean Screen Geometries for Carrier Battlegroup Transits Under the 1990s Threat**	**57**
David Charles McDonnell **Lieutenant, U.S. Navy**	**Optimal Linear Array Heading in a Directional Noise Field**	**57**
Richard Jene Nissen, Jr. **Lieutenant, U.S. Navy**	**Feasibility for the Integration of ASW Information Databases**	**58**
Glenn A. Omans, II **Lieutenant, U.S. Navy**	**Broadband Modal Beamforming of Acoustic Tomography Signals Acquired by a Vertical Array**	**58**
Sean F. Patton **Lieutenant, U.S. Navy**	**Utilization of the Navy's Existing ASW Databases**	**58**
Brian F. Philipp **Lieutenant Commander, U.S. Navy**	**A Categorical Analysis of Weapon System Accuracy Trial (WSAT) Data**	**59**
David E. Sanders **Lieutenant, U.S. Navy**	**Continued Investigation of the Use of Passive Resonators to Improve the Performance of a Low Frequency Sonar Transducer**	**59**

Wade Herman Schmidt **Lieutenant, U.S. Navy**	**A Methodology for Determining Third World Submarine Capabilities Case Study: Iran**	**60**

COMPUTER SCIENCE

Richard James Abresch **Lieutenant, U.S. Navy**	**Path Tracking using Simple Planar Curves**	**63**
Metin Balci **Lieutenant Junior Grade** **Turkish Navy** **and Erhan Saridogan** **Lieutenant Junior Grade** **Turkish Navy**	**Design and Implementation of a Graphical User Interface for a Multimedia Database Management System**	**63**
Willie Kelly Bolik **Lieutenant, U.S. Navy** **and Richard Thomas Irwin** **Lieutenant, U.S. Navy**	**The Integration System for the Low-Cost Combat Direction System**	**64**
Donald P. Brutzman **Lieutenant Commander, U.S. Navy**	**NPS AUV Integrated Simulator**	**64**
Tymothy W. Caddell **Captain, U.S. Army**	**Three-Dimensional Path Planning for the NPS II AUV**	**65**
Neil Kenneth Cadwallader **Captain, U.S. Marine Corps**	**Telecommunications Trends**	**65**
Peng-tso Chang **Lieutenant Commander, ROC Navy**	**Evaluation and Improvement of the ASW System Evaluation Tool**	**66**
Evyatar Chelouche **Major, Israel Air Force**	**Using Object-Oriented Databases for Implementation of Interactive Electronic Technical Manuals**	**66**
Mark A. Compton **Lieutenant Commander, U.S. Navy**	**Minefield Search and Object Recognition for Autonomous Underwater Vehicles**	**67**
Joseph M. Cooke **Major, U.S. Marine Corps**	**NPSNET: Flight Simulation Dynamic Modeling using Quaternions**	**67**
Leif Alan Dahl **Lieutenant, U.S. Navy**	**NPSNET: Aural Cues for Virtual World Immersion**	**68**
John A. Daley **Lieutenant Commander, U.S. Navy**	**Hyper-NPSNET: A Virtual World with an Integrated 3D Hypertext**	**68**
Lori L. DeLooze **Lieutenant, U.S. Navy**	***ITS Ada*: An Intelligent Tutoring System for the Ada Programming Language**	**69**

Atilla N. Demirhan Lieutenant Junior Grade Turkish Navy	On Increasing the Effective Blocking Factor of a Matrix for a Given Cache Organization	69
Robert M. Dixon Captain, U.S. Marine Corps	The Design and Implementation of a User Interface for the Computer Aided Prototyping System	70
Andrew P. Dwyer Captain, U.S. Marine Corps and Garry Wayne Lewis Major, U.S. Marine Corps	The Development of a Design Database for the Computer-Aided Prototyping System	70
Stephen Charles Filippi Lieutenant, U.S. Navy	Implementing Relational Operations in an Object-Oriented Database	71
Alan Lee Fink Lieutenant, U.S. Navy	Object-Oriented Programming: An Assessment of Fundamental Concepts and Design Considerations	71
Gregory Alan Hammond Lieutenant, U.S. Navy	The Instrumentation of a Parallel, Distributed Database Operation, Retrieve-Common, for Merging Two Large Sets of Records	72
Jonathan Edward Hartman Captain, U.S. Marine Corps	Hypercube Solutions for Conjugate Directions	72
William Charles Hoppe Captain, U.S. Army	Cognitive Modeling and the Evolution of the Student Model in Intelligent Tutoring Systems	73
Patricia B. Jensen Lieutenant, U.S. Navy	Historical Overview of Data Communication with Analysis of a Selective Repeat Protocol	73
Benjamin Edward Jones Lieutenant, U.S. Navy	Improving Security in the Fiber Distributed Data Interface (FDDI) Protocol	74
Constantine Karageorgis Lieutenant, Hellenic Navy	A Study of Current World Telecommunications and a Projection of the Future	74
Garry Wayne Lewis Major, U.S. Marine Corps and Andrew P. Dwyer Captain, U.S. Marine Corps	The Development of a Design Database for the Computer-Aided Prototyping System	75
Chang-Tsun Li Captain, ROC Army	User Interface of DFQL: An Object-Oriented Approach	75
Robert Steven Lovejoy Lieutenant, U.S. Navy	Turtle Graphics Implementation using a Graphical Dataflow Programming Approach	76
Sybil Bettis Mack Lieutenant, U.S. Navy	The Design and Implementation of a Functional Interface for the Attribute-Based Multi-Lingual Database System	76

Dawn Marie Maskell **Lieutenant, U.S. Navy**	**Concept Flow Diagrams: Method for Design of Computer-Aided Instruction**	**77**
Robert C. McArthur **Captain, U.S. Marine Corps**	**Design and Specification of a High Speed Transport Protocol**	**77**
James B. McKeon **Lieutenant, U.S. Navy**	**Incorporation of GPS/INS into Small Autonomous Underwater Vehicle Navigation**	**77**
David Allan Nash **Captain, U.S. Army**	**NPSNET: *Modeling the In-Flight and Terminal* Properties of Ballistic Munitions**	**78**
Michael D. O'Loughlin **Captain, U.S. Marine Corps**	**Version and Variation Control of a Design Database for a Computer-Aided Prototyping System**	**78**
Hyun Kyoo Park **Captain, ROK Army**	**NPSNET: Real-Time 3-D Ground-Based Vehicle Dynamics**	**78**
Gary B. Parker **Lieutenant Commander, U.S. Navy**	**Genetic Algorithms for the Development of Real-Time Multi-Heuristic Search Strategies**	**79**
Kevin Robert Peterson **Lieutenant, U.S. Navy**	**Visual Navigation for an Autonomous Mobile Vehicle**	**79**
Tilemahos Poulis **Lieutenant, Hellenic Navy**	**Using an Object-Oriented Database Management System to Enhance the Reusability of Class Definitions**	**80**
William David Reese **Captain, U.S. Army**	**A Technical Review of Cellular Radio and Analysis of a Possible Protocol**	**80**
John Robert Ross **Lieutenant, U.S. Navy**	**Group Decision Support System to Aid the Process of Design and Maintenance of Large Scale Systems**	**81**
Matthew James Rothlisberger **Captain, U.S. Army**	**A Tool for Automated Validation of Network Protocols**	**81**
Jeffrey Mark Schweiger **Lieutenant Commander, U.S. Navy**	**Detecting Potential Synchronization Constraint Deadlocks from Formal System Specifications**	**81**
Jennie Marie Sealander **Lieutenant, U.S. Naval Reserve**	**Building Resuable Software Components for Automated Retrieval**	**82**
Ronald L. Spear **Captain, U.S. Army**	**A Relational/Object-Oriented Database Management System: R/OODBMS**	**82**
James Earl Stein **Lieutenant, U.S. Navy**	**Modelling, Visibility Testing, and Projection of an Orthogonal Three Dimensional World in Support of a Single Camera Vision System**	**82**

Liek Foo Tan **Ministry of Defense** **Singapore**	**Motion Planning for Rigid Body Robots**	**83**
Leonard Tharpe **Captain U.S. Army**	**A Study on the Effectiveness of Lockup-Free Caches for a Reduced Instruction Set Computer (RISC) Processor**	**83**
Vassilios Theologitis **Lieutenant, Hellenic Navy**	**Private and Shared Data in Object-Oriented Programming**	**84**
Julia Ann Thur **Lieutenant Commander, U.S. Navy**	**Multimedia: The Case with the Army's Single Exercise Analysis System Prototype**	**84**
Jon Curtis Walter **Captain, U.S. Army** **and Patrick Theron Warren** **Captain, U.S. Army**	**NPSNET: JANUS-3D Providing Three-Dimensional Displays for a Traditional Combat Model**	**85**
Alan Keith Walters **Lieutenant, U.S. Navy**	**NPSNET: Dynamic Terrain and Culture Feature Depiction**	**85**
Patrick Theron Warren **Captain, U.S. Army** **and Jon Curtis Walter** **Captain, U.S. Army**	**NPSNET: JANUS-3D Providing Three-Dimensional Displays for a Traditional Combat Model**	**86**
William Ronald Weigeshoff **Captain, U.S. Army**	**An Automated Reconnaissance and Surveillance Planning Tool**	**86**
Stefan A.H. Westman **Major, Swedish Army**	**Design and Implementation of a Data Model for the NPS ARGOS Project**	**87**
Michael Andrew Williams **Lieutenant, U.S. Navy**	**The Testing, Analysis, and Correction of the Update Operation of a Parallel, Multi-Backend Supercomputer**	**87**
Kalin Paxton Wilson **Lieutenant, U.S. Navy**	**NPSGDL: An Object-Oriented Graphics Description Language for Virtual World Application Support**	**87**

ELECTRICAL ENGINEERING

John W. Andre **Lieutenant, U.S. Navy**	**Feasibility Study of Implementing a Code Division Multiple Access Data Link Utilizing Fiber Optic Delay Lines**	**91**
Harold A. Bell **Lieutenant, U.S. Navy**	**A Compile-Time Approach for Chaining and Execution Control in the AN/UYS-2 Parallel Signal Processor**	**91**
Troy Allen Bentz **Lieutenant, U.S. Navy**	**Electrical Noise Control with Applications to Electronic Intelligence Gathering Aircraft**	**91**

Gary Bibeau **Captain, U.S. Marine Corps**	**Design and Implementation of a Token-Ring Fiber Optic Local Area Network**	**92**
Vance A. Brahosky **Lieutenant, U.S. Navy**	**A Combinatorial Approach to Automated LOFARGRAM Analysis**	**92**
Paul Eugene Brochard **Lieutenant, U.S. Navy**	**Analysis of Simulation Tools for the Study of Advanced Marine Power Systems**	**92**
Jen-Peng Che **Lieutenant Commander, ROC Navy**	**Analysis of Constant Phase Contours of Evaporation Duct Mode Functions for Waveguide Mode Propagation**	**93**
Chung-Jung Chiang **Lieutenant Commander, ROC Navy**	**Applications of the *Total Least Squares* Technique to Frequency Estimation**	**93**
Javier Mauricio Covelli **Lieutenant, U.S. Navy**	**Ferroelectric Memory Devices and a Proposed Standardized Test System Design**	**93**
Thomas J. Doran **Captain, U.S. Marine Corps**	**Design and Implementation of a Fiber Optic Link for a Token Local Area Network**	**94**
Robert C. Earle **Lieutenant, U.S. Navy**	**Minimization of Multiple-Valued Programmable Logic Array Using Simulated Annealing**	**94**
Stanley Earl Engle **Lieutenant, U.S. Navy**	**Roundoff Algorithms for Digital Phase Shifters that Minimize Beam Shift**	**95**
Marco Aurelio Guimares Falcao **Lieutenant Commander,** **Brazilian Navy**	**Allocation of Periodic Tasks with Precedences on Transputer-Based Systems**	**95**
Milton Pinto Ferreira **Lieutenant Commander,** **Brazilian Navy**	**Fast High-Resolution Techniques Applied to the Direction of Arrival (DOA) of Signals Problem**	**96**
Robert M. Francis **Lieutenant, U.S. Navy**	**A Computer Model for the Transmission Characteristics of Dielectric Radomes**	**96**
Dorothy J. Freer **Lieutenant, U.S. Navy**	**Development of a MATLAB Toolbox for Image Processing**	**96**
Christopher N. Gedo **Lieutenant, U.S. Naval Reserve**	**Computer Analysis of Harmonic Distortion in Electrical Power Distribution Systems**	**97**
John Reynold Gensure **Lieutenant, U.S. Navy**	**Extended Surface Heat Sinks for Electronic Components: A Computer Optimization**	**97**
Thomas Charles Gonter **Captain, U.S. Marine Corps**	**A Microprocessor Interface for the NM24CF04 Serial-Access Ferroelectric Memory**	**98**

Bobby Gene Gregory, Jr. **Captain, U.S. Marine Corps**	**Computer Modeling of Tactical High Frequency Antennas**	**98**
Karen Allyn Hagerman **Lieutenant, U.S. Navy**	**Instantaneous Power Spectrum and 1½D Instantaneous Power Spectrum Techniques**	**98**
Yin-Yuan Han **Lieutenant Commander, ROC Navy**	**Revising M-Layer: Complex Exponent Representation**	**99**
John C. Heiss **Lieutenant, U.S. Navy**	**Image Processing with the Naval Postgraduate School Infrared Search and Target Designation System**	**99**
Dale Herdegen **Captain, U.S. Marine Corps**	**Adaptive Noise Cancellation Applied to the NUWES Test Ranges**	
Billy E. Hudgins, Jr. **Lieutenant, U.S. Navy**	**Implementation of Fuzzy Inference Systems using Neural Network Techniques**	**100**
George A. Hutcheson **Lieutenant, U.S. Navy**	**Implementation of the One-Bit Spectral Correlation Algorithm**	**100**
David Andrew Jakubek **Lieutenant, U.S. Navy**	**Coherent/Noncoherent Detection of Coherent Optical Heterodyne DPSK-CDMA and MFSK-CDMA Signals**	**100**
Mark Russell Kalmbach **Captain, U.S. Marine Corps**	**Wavelet-Based Multiresolution Analyses of Signals**	**101**
Hakan Karazeybek **Lieutenant Junior Grade** **Turkish Navy**	**Fast Reaction Missile Control for Point Defense**	**101**
John W. Larkin **Lieutenant, U.S. Navy**	**The Prediction of the Performance of a Microcircuit Heat Sink in the Boiling Mode**	**101**
Dimitrios Theodoros Lazaris **Lieutenant, Hellenic Navy**	**Design and Evaluation of Portable Antennas for Location of Sources of Radio Noise Emanating from Power-Line Hardware**	**102**
Joey E. Legaspi **Lieutenant, U.S. Navy**	**One- and Two-Dimensional Discrete Wavelet Transforms**	**102**
Karen K. Lehman **Lieutenant, U.S. Navy**	**Function Allocation in a Robust Distribution Real-Time Environment**	**103**
Brian S. Little **Lieutenant, U.S. Navy**	**A Technique for Predictable Real-time Execution in the AN/UYS-2 Parallel Signal Processing Architecture**	**103**

Donyslos Makris **Lieutenant Junior Grade** **Hellenic Navy**	**Real-time Scheduling and Synchronization for the NPS Autonomous Underwater Vehicle**	**104**
Terry E. Mayfield **Lieutenant, U.S. Navy**	**Computerized Diagnostic Analyzer for SSBN 726 Class Low Voltage DC Weapon Power System**	**104**
Jacqueline R. McClusky **Lieutenant, U.S. Navy**	**Active Damping of Vibrations on Space Station Freedom using Linear Quadratic Gaussian Control and H∞ Control**	**104**
Steven J. McPhillips **Lieutenant, U.S. Navy**	**Adaptive Filter Design using Discrete Orthogonal Functions**	**105**
Kurt William Menke **Lieutenant, U.S. Navy**	**Nonlinear Adaptive Control using Backpropagating Neural Networks**	**105**
Christopher A. Miller **Lieutenant, U.S. Navy**	**An Application of Extended Kalman Filtering to a Model-Based, Short-Range Navigator for an AUV**	**105**
Gregory A. Miller **Lieutenant, U.S. Navy**	**A Circuit Model for Two-Path Cutoff Waveguide Dielectric Resonator Filters**	**106**
Kurtis Brett Miller **Lieutenant, U.S. Navy**	**Design of Robust Suboptimal Controllers for a Generalized Quadratic Criterion**	**106**
Timothy Brian Mull **Lieutenant, U.S. Navy**	**Use of Minimum Time Controllers in Vertically-Launched Surface-to-Air Missiles**	**106**
Steven John Nagengast	**Correction of Inertial Measurements Using GPS Updates for Underwater Navigation**	**107**
Phong Nguyen **Lieutenant, U.S. Navy**	**Public-Key Cryptography: A Hardware Implementation and Novel Neural Network-Based Approach**	**107**
Manuel Vijia Ordonez **Lieutenant, U.S. Navy**	**Method of Moments Analysis of Symmetric Dual Reflector Antennas with Feeds**	**107**
Robert Earl Parker, Jr. **Lieutenant, U.S. Navy**	**Fixed and Data Adaptive Kernels in Cohen's Class of Time-Frequency Distributions**	**108**
Ronnie D. Puett **Lieutenant, U.S. Navy**	**Reconfiguration in Robust Distributed Real-Time Systems Based on Global Checkpoints**	**108**
John H. Quint **Lieutenant, U.S. Navy**	**Development of an NPS Middle Ultraviolet Spectrograph (MUSTANG) Electronic Interface Package**	**109**
Clay Allen Richmond **Lieutenant, U.S. Navy**	**On Programming Transputers to Capture Ada Multitasking for the NPS Autonomous Underwater Vehicle**	**109**

Dean A. Richter **Lieutenant, U.S. Navy**	**Iterative System Modeling using Multigrid Techniques**	**110**
Miguel Angel Betancourt Rivas **Lieutenant Colonel,** **Venezuelan Air Force**	**Coded Performance of a Fast Frequency-Hopped Noncoherent BFSK Ratio-Statistic Receiver over a Rician Fading Channel with *Partial-Band Interference***	**110**
Nicholas Francis Russo **Lieutenant, U.S. Coast Guard**	**The Design of an Adaptive Attitude Control System**	**110**
John B. Scout **Lieutenant Commander, U.S. Navy**	**Detection of Binary Phase Shift Keyed Signals in Extremely High Noise Levels**	**111**
Salih Semerciler **Lieutenant Junior Grade** **Turkish Navy**	**Coded Orthogonal Signaling**	**111**
Irma Sityar **Lieutenant, U.S. Navy**	**Sun Sensor Implmentation using Solar Power Arrays**	**111**
Brian E Skimmons **Lieutenant, U.S. Navy**	**Automated Performance Evaluation Technique**	**112**
Steven M. Smith **Lieutenant, U.S. Navy**	**The Use of Electrical Transmission Line Theory to Predict the Performance of Spacecraft Radiators**	**112**
Raymond Scott Starsman **Lieutenant, U.S. Navy**	**A Hopfield Network Approach to Direct Adaptive Control of Nonlinear Systems**	**113**
Chin Hock Teo **Major, Republic of** **Singapore Air Force**	**Back-Propagation Neural Networks in Adaptive Control of Unknown Nonlinear Systems**	**113**
Frank R. Thorngren **Lieutenant, U.S. Navy**	**Kalman Smoother Applied to LACE**	**114**
Chien C. Tsai **Lieutenant Colonel, ROC Army**	**Multilevel Security with Data Compression and Restricted Characters Set Translation**	**114**
Randall Jay Tucker **Lieutenant, U.S. Naval Reserve**	**Coupling Losses in Multiple Beam Antennas**	**114**
Terry G. Tutt **Lieutenant, U.S. Navy**	**Design of Microcontroller Software for a Satellite-Based Ferroelectric Capacitor Experiment**	**115**
John G. Upton **Lieutenant Colonel, U.S. Marine Corps**	**Microcomputer Simulation of a Fourier Approach to Optical Wave Propagation**	**115**

Gregg A. Van Splinter	Incorporating AFEWC IMOM as an Instructional Asset for NPS Radar and Electronic Warfare Curricula	116
Kayhan Vardareri Lieutenant Junior Grade, Turkish Navy	Minimum Time Control of a Third Order Regulator	116
Nissan Vered Lieutenant Commander Israeli Navy	Method of Moments Analysis of Displaced-Axis Dual Reflector Antennas	116
Patrick J. Vincent Lieutenant, U.S. Navy	Effects of Fading and Data Modulation on Noncoherent M-Sequence Acquisition Schemes	117
Bruce A. Walter	The use of Conformal Subdomain Basis Functions in the Method of Moments Computations for a Thin Wire	117
Charles H. Wellington, Jr. Lieutenant, U.S. Navy	Backpropagation Neural Network for Noise Cancellation Applied to the NUWES Test Ranges	117
Je-Jung Young Captain, Korean Army	Data Compression and Archiving Software Implementation and Their Algorithm Comparison	118
Michael Lee Zimmer Lieutenant, U.S. Navy	A VLSI Design of a Radix-4 Floating Point FFT Butterfly	118

ENGINEERING ACOUSTICS

Kevin Mark Blum Lieutenant, U.S. Navy	Acoustically Probed Taylor-Couette Flow Apparatus	121
Antonio J. Carocho Lieutenant, Portuguese Navy	Acoustic Impedance of Materials from Reverberation Time	121
Mary Beth A. Chipkevich Lieutenant, U.S. Navy	Design and Fabrication of a Fiber-Optic Interferometric Accelerometer System	121
Steven Edward Crocker Lieutenant, U.S. Navy	Time Domain Modal Beamforming for a Near Vertical Acoustic Array	122
Stephen J. Dorff Lieutenant, U.S. Navy	Apparatus for Measuring the Absorption of Sound by Noise in One Dimension	122
John Mark Elliott Lieutenant Commander, U.S. Navy	Simulation of Acoustic Multipath Arrival Structure in the Barents Sea	123

Trevor N. Jones **Lieutenant Commander,** **Royal Australian Navy**	**Ocean Bottom Modeling for Ray Acoustics**	**123**
Kyung Taek Lee **Lieutenant, ROK Navy**	**Evaluation of the Computational Validity of the Image Model in Predicting the Sound Field in a Wedge-Shaped Layer using Acoustical Reciprocity**	**123**
George Nassopoulos **Lieutenant Junior Grade** **Hellenic Navy**	**Study of Sound Propagation in a Wedge-Shaped Ocean and Comparison with Other Methods**	**124**
Leo H. Ostwald, Jr. **Lieutenant, U.S. Navy**	**Predicting the Underwater Sound of Moderate and Heavy Rainfall from Laboratory *Measurements of* Radiation from Single Large Raindrops**	**124**
David E. Sanders **Lieutenant, U.S. Navy**	**Continued Investigation of the use of Passive Resonators to Improve the Performance of a Low Frequency Sonar Transducer**	**125**
Christopher D. Scofield ***Lieutenant, U.S. Navy***	**Oscillating Microbubbles Created by Water Drops Falling on Fresh and Salt Water: Amplitude, Damping and the Effects of Temperature and Salinity**	**125**
Cleon A. Walden, Jr. **Lieutenant, U.S. Navy**	**Numerical Investigations of Breather Solitons in Nonlinear Vibratory Lattices**	**126**
Charles Joseph Young, Jr. **Lieutenant Commander, U.S. Navy**	**Symbolic Solution of a Multilayer Ocean Waveguide Problem with Arbitrary, Depth Dependent Ambient Density and Sound Speed Profiles**	**126**

ENGINEERING SCIENCE

Matthew B. Cissel **Lieutenant, U.S. Navy**	**Elevated Temperature Properties of a Dispersion Strengthened Al-[Fe, V, Si] Alloy**	**129**
Leopoldo Dolano Gil, Jr. **Lieutenant, U.S. Navy**	**A Comparison of Three Computer Weapon-Target Endgame Simulations for Aircraft**	**129**
John David Guglielmi **Lieutenant, U.S. Navy**	**Atomization of JP-10\B_4C Gelled Slurry Fuel**	**129**
Blake D. Huguenin **Lieutenant, U.S. Navy**	**Design, Development and Testing of a Prototype Optical System for a Next Generation Multiplexed Imager**	**130**

Ioannis Kapelios **Lieutenant Colonel** **Hellenic Army**	**Stability of Turning Rate Guidance and Control Laws for Autonomous Vehicles**	**130**
Chang Ho Kim **Major, ROK Air Force**	**Flow Visualization Studies of a Sideslipping, Canard-Configured X-31A-Like Fighter Aircraft Model**	**130**
Chris D. Meyer **Lieutenant, U.S. Navy**	**Processing, Microstructure and Superplasticity in Al-Mg-Mn Alloys**	**131**
John Blackwelder Nowell, Jr **Lieutenant, U.S. Navy**	**Missile Total and Subsection Weight and Size Estimation Equations**	**131**
Akira Suka **Lieutenant, Maritime Self Defense Force of Japan**	**Microstructure and Mechanical Properties of High Copper HSLA-100 Steel in 2-inch Plate Form**	**132**
Panurit Yuktadatta **Lieutenant, Royal Thai Navy**	**Simulation of a Parallel Processor-Based Small Tactical System**	**132**

INFORMATION SYSTEMS

Ann Grayson Abbott **Lieutenant, U.S. Navy** **and Mona Rose Busch** **Lieutenant, U.S. Navy**	**An Investigation of Requirements Traceability to Support Systems Development**	**135**
Diana Lawrence Baker **Major, U.S. Army**	**An Experimental Investigation of the Effects of Software Size Increase on Software Project Management Behavior**	**135**
Robert Eugene Baker, Jr. **Lieutenant Commander, U.S. Navy**	**A Study of Novice Systems Analysts' Problem Solving Behaviors using Protocol Analysis**	**135**
Kathleen Ann Beernink **Lieutenant, U.S. Navy**	**A Conceptual Database Design of a Naval Shore Command Management Information System**	**136**
Kamin Adrienne Bell **Lieutenant, U.S. Navy**	**An Information Systems Architectue Analysis for Naval Air Systems Command**	**136**
Lawrence Paul Bittner **Lieutenant, U.S. Navy**	**Conversion and Retrievability of Hard Copy and Digital Documents on Optical Disks**	**136**
Cheryl D. Blake **Lieutenant, U.S. Navy**	**Software Development with Application Generators: the Naval Aviation Logistics Command Management Information System (NALCOMIS) Case**	**137**
Michael Thomas Bourque **Lieutenant, U.S. Navy**	**A Framework for Classifying and Resolving Semantic Heterogeneity in Object-Oriented Databases**	**137**

William Stevenson Bowman **Lieutenant, Supply Corps** **U.S. Navy**	**Communication Module for the Micro-Based Small Purchase Contracting Program**	**137**
Richard K. Boyd **Lieutenant Commander,** **U.S. Naval Reserve**	**A Weapons Systems Development Decision Support System**	**138**
William C. Branley, Jr.	**Modeling Observation in Intelligent Agents: Knowledge and Belief**	**138**
David G. Broadwater **Lieutenant, U.S. Navy**	**The Obstacles Encountered in the Development SMMS: A Case Study**	**138**
Mona Rose Busch **Lieutenant, U.S. Navy** **and Ann Grayson Abbott** **Lieutenant, U.S. Navy**	**An Investigation of Requirements Traceability to Support Systems Development**	**139**
Joseph P. Cavanaugh **Lieutenant, U.S. Navy**	**The Social and Behavioral Impacts of Information Systems in the Automated Office: A Literature Review**	**139**
Dennis K. Christensen **Lieutenant Commander, U.S. Navy** **and Magno O. Pasadilla, Jr.** **Lieutenant, U.S. Navy**	**The Design of a Prototype Personal Computer Database for the Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS)**	**140**
Conrad C. Chun **Lieutenant, U.S. Navy** **and William R. Estrada** **Lieutenant, U.S. Navy**	**SNAP III Training Administrative Subsystem Integrated Functional Description**	**140**
Timothy P. Costello **Lieutenant, U.S. Navy**	**Anchoring-and-Adjustment in Software Project Management: An Experimental Investigation**	**141**
Michael E. Culpepper **Captain, U.S. Army**	**Tactical Decision Making in Intelligent Agents: Developing Autonomous Forces in NPSNET**	**141**
Kris Otis Davis **Lieutenant, U.S. Navy**	**A Password Comparison: Which Ones are Hardest to Break?**	**141**
David Foster DeFord **Commander, U.S. Navy**	**Application of Optical Disc Databases and Related Technology to Public Access Settings**	**142**
David G. Dickison **Lieutenant, U.S. Navy**	**Implementation of a Configuration and Maintenance Management System for Local Area Networks**	**142**

Christine M. Donohue Lieutenant, U.S. Navy and Gregory A. Hayes Lieutenant, U.S. Navy	**Data Management: Implementation and Lessons Learned from Department of the Army Data Management Program**	**143**
Richard Charles Dowler Captain, U.S. Marine Corps	**Naval Postgraduate School Scheduling System (NPS^3)**	**143**
Gilliam E. Duvall Lieutenant Commander, U.S. Naval Reserve and Mary Jo Elliott Lieutenant, U.S. Navy	**Business Re-Engineering: Lessons Learned from the U.S. Army Corps of Engineers Modernization Program**	**144**
Mary Jo Elliott Lieutenant, U.S. Navy and Gilliam E. Duvall Lieutenant Commander, U.S. Naval Reserve	**Business Re-Engineering: Lessons Learned from the U.S. Army Corps of Engineers Modernization Program**	**144**
William R. Estrada Lieutenant, U.S. Navy and Conrad C. Chun Lieutenant, U.S. Navy	**SNAP III Training Administrative Subsystem Integrated Functional Description**	**145**
Marcus Gene Foote Lieutenant, U.S. Navy	**A Framework for Selection of DSS Development Methodology**	**145**
Scott Eugene Foster, III Lieutenant, Medical Service Corps U.S. Navy	**Surplus Value in Organizational Communication**	**146**
Timothy Allen Foster Lieutenant, U.S. Navy	**C^2 Information Management: Data Fusion and Track ID's in a Multiple Sensor Environment**	**146**
Steven Lee Gaudreau Captain, U.S. Marine Corps	**The Effect of Information Systems on Middle Managment in the Aerospace Industry: The Westco Case**	**146**
Richard John Hale Lieutenant, U.S. Navy	**The Development of a Scheduling Application in Support of the Paperless Ship**	**147**
Gerard R. Harms Lieutenant Commander, U.S. Navy and Tina H. Van Hook Lieutenant, U.S. Navy	**A Clearinghouse for Software Reuse: Lessons Learned from the RAPID/DSRS Initiatives**	**147**
Gregory A. Hayes Lieutenant, U.S. Navy and Christine M. Donohue Lieutenant, U.S. Navy	**Data Management: Implementation and Lessons Learned from Department of the Army Data Management Program**	**148**

Richard E. Hodgkins **Lieutenant, U.S. Navy**	**The Design and Implementation of ZTRAX: A Training, Readiness and Flight Hour Relational Database Management Tracking System**	**148**
Jonathan Grady Howe **Lieutenant, U.S. Navy**	**Development and Implementation of Information Systems at Two California Water Districts**	**149**
Peter J. Hural **Major, U.S. Marine Corps**	**Comparative Assessment of U.S. Marine Corps Disaster Recovery Plans for Information Systems**	**149**
Robert J. Ivey, Jr. **Lieutenant, U.S. Navy**	**Diagnostic Expert Systems use in the United States Navy**	**149**
Charles Albin Jennings **Lieutenant, U.S. Navy**	**Re-Engineering Software Systems in the Department of Defense using Integrated Computer-Aided Software Engineering Tools**	**150**
Mark Todd Kohlheim **Lieutenant U.S. Navy**	**Analysis, Design, and Implementation of a Database Management System for the Naval Postgraduate School Alumni Association**	**150**
William C. Kotheimer, Jr. **Lieutenant, U.S. Navy**	**A Database to Support DoD Business Process Redesign**	**151**
Geraldine Susan Krotow **Lieutenant U.S. Navy**	**The Impact of Cognitive Feedback on the Performance of Intelligence Analysts**	**151**
Christopher James Lane **Captain, U.S. Army** **and John Wesley Monk** **Captain, U.S. Army**	**Decisionmaking in *Military Command Teams:* An Experimental Study**	**152**
Daniel A. Lindsey **Lieutenant, U.S. Navy**	**A Framework for Classifying and Resolving Semantic Conflicts using the Enhanced Entity-Relationship Model**	**152**
Mark S. Lockhart **Lieutenant Commander,** **Medical Service Corps,** **U.S. Navy**	***Evaluation of* a User Information Satisfaction Short-Form Instrument**	**153**
Roger L. McDonald, III **Captain, U.S. Army**	**The Structure of the Computer Industry**	**153**
Andrew Charles Metcalf **Lieutenant, U.S. Coast Guard**	**Analysis of Multimedia Information Systems for the U.S. Coast Guard**	**154**
John Wesley Monk **Captain, U.S. Army** **and Christopher James Lane** **Captain, U.S. Army**	**Decisionmaking in Military Command Teams: An Experimental Study**	**154**

Jeffrey Scott Nolan Lieutenant, U.S. Navy and Phillip Douglas Youngblood Lieutenant Commander, U.S. Navy	Naval Postgraduate School Scheduling Support System (NPS^4)	155
John Bradford Owen Lieutenant, U.S. Navy	Negotiation Support Systems's Impact on the Socio-Emotional Environment: A Research Design Framework	155
Magno O. Pasadilla, Jr. Lieutenant, U.S. Navy and Dennis K. Christensen Lieutenant Commander, U.S. Navy	The Design of a Prototype Personal Computer Database for the Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS)	156
Mark Alan Paylor Lieutenant Commander, U.S. Navy	Risk Assessment of LAN Communications	156
Timothy B. Pence Lieutenant, U.S. Navy	A Comparative Evaluation of Computer Access Controls	156
Paul Steven Posey Lieutenant, U.S. Navy	A Prototype Graphical User Interface for Co-oP: A Group Decision Support System	157
Richard A. Powers Lieutenant, U.S. Navy	Continuous Speech Recognition as an Input Method for Tactical Command Entry in the SH-60B Helicopter	157
David Allan Prevost Lieutenant, U.S. Navy	Security Issues in the Defense Data Network	157
Matthew Curran Ragan Lieutenant, U.S. Navy	Administrative Sciences Department Travel Database System	158
Robert D. Randall, Jr Lieutenant, U.S. Navy	Examinaton and Implementation of a Proposal for a Ph.D.. Program in Administrative Sciences	158
Mark C. Rhoads Lieutenant Commander, U.S. Navy	Determination of Optimal Training Methodologies for Discrete/Dependent Speech Recognition (SR) Systems	158
Ron M. Richardson Commander, U.S. Naval Reserve	Economic Analysis of Redesign Alternatives for the RESFMS Information System	159
Eric Scott Ringwall Lieutenant, U.S. Navy	A Design Framework for Coordination Support Systems	159
David Michael Rust Lieutenant, U.S. Navy	An Introduction ot X Window Application Development	160
Ralph Sabene Lieutenant Commander U.S. Naval Reserve	Designing a Graphical User Interface for a Bilateral Negotiation Support System	160

Michael Jerome Salters **Lieutenant, U.S. Navy**	**Computer Virus Security in DoN**	**161**
Cynthia Ellen Schwind **Lieutenant Commander,** **U.S. Naval Reserve**	**Automated Manpower Analysis and Personnel Management System (AMA/PMS)**	**161**
Campbell P. Shannon **Lieutenant, U.S. Navy**	**An Evaluation of the Need for Local Area Networks at Naval Aviation Squadrons and Wings**	**162**
Warren J. Soong **Captain, U.S. Marine Corps**	**Ada Implementation Issues as Discovered through a Literature Survey of Applications Outside the United States**	**162**
Steven Wayne Smith **Lieutenant, U.S. Navy**	**Information Systems: How They Affect and are Affected by Organization Structure**	**163**
Timothy P. Steele **Lieutenant Commander, U.S. Navy**	**Design and Implementation of a Patient Tracking and Recall System for Branch Dental Clinc Monterey**	**163**
Jeffrey J. Stenzoski **Lieutenant Commander, U.S. Navy**	**X Window Application Extension with the Andrew Toolkit**	**163**
Todd David Stephan **Captain, U.S. Marine Corps**	**The Use of Statistical Measures to Validate System Dynamics Models**	**164**
Brian E. Tansey **Lieutenant, U.S. Navy**	***Development of a Faculty Research and Publication Database System***	**164**
David J. Toy **Captain, U.S. Army**	**Comparison of Graphical Terrain Resolutions by Scenario for the Janus(A) Combat Model**	**164**
Tina H. Van Hook **Lieutenant, U.S. Navy** **and Gerard R. Harms** **Lieutenant Commander, U.S. Navy**	**A Clearinghouse for Software Reuse: Lessons Learned from the RAPID/DSRS Initiatives**	**165**
Reginald Wayne Vaughn **Lieutenant, U.S. Navy**	**Computer Security Concepts and Issues in the Information Technology Management (370) Curriculum**	**165**
Scott Alan White **Lieutenant Commander, U.S. Navy**	**Modeling Process Redesign**	**165**
Brian Kenneth Wright **Lieutenant, U.S. Coast Guard**	**Adding Intelligence to the Composite Warfare Commander - Distributed Dynamic Decisionmaking (CWC-DDD) Paradigm**	**166**

Phillip Douglas Youngblood **Lieutenant Commander, U.S. Navy** **and Jeffrey Scott Nolan** **Lieutenant, U.S. Navy**	**Naval Postgraduate School Scheduling Support System (NPS^4)**	**166**
Robert A. Zellmann **Lieutenant Commander, U.S. Navy**	**Faculty Workload Database System (FWDS) for the Administrative Sciences Department: Analysis, Design, and Implementation**	**167**

MANAGEMENT

Elmer John A. Aguigam **Lieutenant, Medical Service Corps** **U.S. Navy**	**Inventory Management of Pharmaceuticals in Authorized Medical/Dental Allowance Lists**	**171**
William Thomas Ainsworth **Lieutenant, U.S. Navy** **and James William Wirwille, Jr** **Lieutenant Commander, U.S. Navy**	**Analysis of a Proposal to Consolidate Aircraft Intermediate Maintenance Capabilities**	**171**
Liaqat Ali **Major, Pakistan Army**	**Recruitment of Quality Soldiers (The Case of the Pakistani Army)**	**172**
Scott Thomas Allen **Captain, U.S. Marine Corps**	**A Taxonomical Structure for Classifying the Services Procured by the Federal Government**	**172**
Curtis S. Ames **Captain, U.S. Marine Corps**	**A Database Processing Application for the Direct Air Support Center**	**173**
Robert R. Asselin **Lieutenant Commander, U.S. Navy** **and Ernest L. Styron, Jr.** **Lieutenant Commander, U.S. Navy**	**Cost Benefit Analysis of General Services Administration's Proposed Relocation**	**173**
Paul K. Augustine **Captain, U.S. Marine Corps** **and W. Drew Rowlands** **Lieutenant, U.S. Navy**	**Benefit/Cost Analysis of Interdwelling Noise Control in Multifamily Dwellings**	**174**
Herman Tokuo Kealaula Awai **Lieutenant, U.S. Navy**	**Double-Stack Containers: Changing the Image of Intermodalism**	**174**
Jeffrey Charles Babos **Lieutenant, U.S. Navy**	**Financial Management of Hazardous Waste Compliance and Mitigation Costs: Constraints and Implications**	**175**
Dal Hyeoung Bae **Captain, ROK Army**	**Internal Control in an EDI Environment**	**175**

Jeffrey T. Bailey **Captain, U.S. Marine Corps**	**The ORINCON Contract: A Case Study of Service Contracting**	**175**
Wayland P. Barber **Captain, U.S. Army**	**Software Acquisition: Evolution, Total Quality Management and Applications to the Army Tactical Missile System**	**176**
Jon T. Barnhill **Lieutenant, U.S. Navy**	**An Assessment of the Relationship between Aptitude Test Scores and Representation of Blacks and Hispanics in U.S. Navy Occupations**	**176**
Stanley M. Beckerdite **Lieutenant Commander, U.S. Navy**	**The use of International Standards Organization ISO 9000 Quality Standards in Place of Military Standards**	**177**
La Toya Bellamy **Lieutenant, U.S. Navy**	**Initial Billet Assignments and the Performance of Naval Officers**	**177**
Robert John Bennett **Lieutenant, Supply Corps** **U.S. Navy**	**Simulated Negotiations: A Measure of Their Effectiveness on Negotiated Outcome**	**178**
Dale Douglas Berg **Captain, U.S. Marine Corps**	**Analylsis of Management Training for Naval Avionics Center**	**178**
Brian Henry Bialas **Lieutenant, U.S. Navy**	**Safety in Petroleum Movement: Is Enough being Done to Protect the Environment?**	**178**
Adnan Bicaksiz **First Lieutenant** **Turkish Army**	**A PC-Based Model for Estimating Regional Recruit Markets**	**179**
Paul Bosco **Lieutenant Commander, Civil Engineer Corps, U.S. Navy**	**Mass Transportation for NPS: A Financial Feasibility Study**	**179**
Mark A. Brown **Lieutenant Commander,** **Supply Corps U.S. Navy**	**A Dictionary of Acquisition and Contracting Terms**	**179**
David Daniel Bruhn **Lieutenant, U.S. Navy**	**The Costs/Benefits of Opening a Skilled Nursing Facility at Naval Hospital, San Diego**	**180**
David W. Brumfield **Lieutenant, U.S. Navy**	**Analysis of Bank Credit Card Contracting at Navy Field Contracting Activities**	**180**
Gerald Francis Burke **Captain, U.S. Marine Corps**	**Improving Training Cost Information at the Naval Avionics Center**	**180**
Randall S. Butler **Lieutenant Commander, U.S. Navy**	**Preliminary Analysis of the J-52 Aircraft Engine Component Improvement Program**	**181**

Carlos D. Buzon, II Lieutenant, Supply Corps U.S. Navy and Michael D. Huggins Lieutenant, Civil Engineer Corps U.S. Navy	Cost/Benefit Analysis of Commander, Naval Surface Force, U.S. Pacific Fleet's, Supply Maintenance Training Team	181
Herbert F. Byrns Lieutenant, U.S. Navy	"Best Value" Contracting in the Procurement of Engineering and Technical Services	182
Thomas Joseph Callan Lieutenant, U.S. Navy	Just-in-Time Contracting in the Department of Defense	182
Dale Scott Chapman Lieutenant, U.S. Navy	The Performance of Naval Reserve Officers Training Corps Graduates at the Surface Warfare Officers School Division Officer Course	182
Sharon Ruth Chapman Lieutenant, U.S. Navy	Stock Fund Aspects of Defense Business Operations Fund	183
Byung Ook Choi Captain, ROK Army	Estimating High Tech Army Recruiting Markets	183
Dennis K. Christensen Lieutenant Commander, U.S. Navy and Magno O. Pasadilla, Jr Lieutenant, U.S. Navy	The Design of a Prototype Personal Computer Database for the Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS)	184
Thomas Neil Collins Captain, U.S. Marine Corps	Enhancing the Physical Fitness in the Marine Corps	184
Benedicto Librado Coloma Lieutenant, U.S. Navy	Analysis of NISTARS Small Parcel Shipping Policy	185
Jeffrey S. Cook Lieutenant Commander, U.S. Navy	Analysis of Consolidation of Intermediate Level Maintenance for Atlantic Fleet T700-GE-401 Engines	185
Michael Francis Corning Lieutenant, Supply Corps U.S. Navy	Government Contracting Under the Javits-Wagner-O'Day Act	185
Jon Francis Cotters Lieutenant, U.S. Navy	A Dictionary of Acquisition and Contracting Terms	186
Dale Patrick Cottongim Lieutenant, Supply Corps U.S. Navy	The Benefits and Inhibitors to the Use of Commercial Item Descriptions at Defense Logistics Agency Supply Centers	186
Charles G. Coutteau Captain, U.S. Army	Cost and Schedule Control Management: What the Department of Defense Major Acquiisition System Program Manager Needs to Know	186

Harlene Nelson Coutteau **Captain, U.S. Army**	**What the Department of Defense Non-Major Acquisition Project Manager Should Know about Cost and Schedule Management**	**187**
Lewis James Coyle **Major, Australian Army**	**The Economic Impacts of Military Installations on Regional Economies**	**187**
Michael Lee Crouch **Captain, U.S. Marine Corps**	**The V-22: Can the Nation Afford to Forgo its Production**	**188**
Gerald L. Crowder **Lieutenant, U.S. Navy**	**Evaluation of the Cost Effectiveness Analysis Model being Developed for the Component Improvement Programs of the Air Force and the Navy**	**188**
William Scott Curry **Lieutenant Commander, U.S. Navy**	**A Procedure for an AFS to Pass Unfilled Aircraft Carrier FILL Requisitions to a Navy Supply Center**	**189**
James Dennis Davis **Lieutenant, U.S. Navy**	**An Appraisal of Cost-Effectiveness Models used in the Air Force and Navy Aircraft Engine Component Improvement Programs**	**189**
Amy Murphy DeWitt **Lieutenant, U.S. Navy**	**Surface Ship Maintenance Planning Process**	**190**
Richard Jacob Dieffenbach **Lieutenant, Civil Engineer Corps** **U.S. Navy**	**Productivity Improvement Opportunities at Navy Public Works Activities**	**190**
Cahit Armagan Dilek **Lieutenant Junior Grade,** **Turkish Navy**	**Turkey's Security Policy and NATO**	**190**
Mehmet Mete Doganay **First Lieutenant,** **Turkish Army**	**A Strategic Planning Process for NATO for the 1990s**	**191**
Donald Frank Dombrowsky **Lieutenant, U.S. Navy**	**Surface Warfare Officer Manpower Utilization: Introduction of Person-Job Matching on the Assignment Process**	**191**
Glenn Cameron Doyle **Lieutenant, U.S. Navy**	**Cost Estimation of Software Development and the *Implications for the Program Manager***	**192**
Robert Michael Dryer **Lieutenant, Supply Corps** **U.S. Navy** **and Robert Lawrence Jacobs** **Lieutenant, Supply Corps** **U.S. Navy**	**A Preliminary Simulation Model for the Advanced Traceability and Control (ATAC) System**	**192**

John C. Espie, IV Lieutenant Commander, Medical Corps, U.S. Navy	An Evaluation of the 1989 Restructuring of the Navy Medical Department from the Perspective of Financial Managers	193
Ben A. Fegurgur Lieutenant Commander, Supply Corps U.S. Navy and Anthony F. Marinello Lieutenant, Supply Corps U.S. Naval Reserve	Potential Impact of the Elimination of the M Account on the Department of the Navy	193
Jennifer P. Ford Lieutenant Commander, U.S. Naval Reserve	Voluntary Separation and Early Retirement Plans: A Survey of Naval Postgraduate School Lieutenant Commanders	194
Gregory P. French Lieutenant, U.S. Navy	OP-12/PERS-5 in the Manpower Process	194
Daniel Jo Gahr Lieutenant Commander, U.S. Navy	An Evaluation of Internal Control for a Non-appropriated Fund Instrumentality (NAFI)	194
David L. Garrard Major, U.S. Marine Corps	An Analysis of the General Services Administration Board of Contract Appeals Bid Protest Decisions and the Effect on Automated Data Processing Equipment/Federal Information Processing Resources Procurements	195
Janet G. Goldstein Lieutenant, U.S. Navy	Financial Criteria used in Case Adjudication by the Directorate for Industrial Security Clearance Review (DISCR)	195
Michael M. Gragen Lieutenant, U.S. Navy	Department of Defense Financial Management Education and Training Programs: A Survey of Quality Assurance Methods	196
Michael Lee Gregory Major, U.S. Marine Corps	A Profile of Scientist and Engineer Training Conducted by the Naval Avionics Center	196
Maury Jayne Grimm Lieutenant, U.S. Navy	Panacea or Perestroika: A Socio-Economic Analysis of the Equity and Efficiency Effects of Choice in Education	196
Anne Katherine Hagstrom Lieutenant, U.S. Navy	Learning Objectives for the Navy Practical Comptrollership Course: A Validation	197
Kevin Lee Hannes Lieutenant, U.S. Navy	TQL, a Case Study of Implementation to the Operational Fleet	197
Jacob Bernard Hansen Captain, U.S. Army	The Legislative Role in the Military Acquisition Process	197

William Decker Hatch, II Lieutenant, U.S. Navy and Lori Danette Swinney Lieutenant, U.S. Navy	Physical Readiness Testing of Surface Warfare Officers	198
Mike A. Haumer Lieutenant, U.S. Navy	Occupational Trends in the Civilian and Navy Labor Markets	198
Howard H. Haynes, Jr. Lieutenant, U.S. Navy	Planning, Programming and Budgeting (PPBS) Budget Review and Congressional Action	198
Anne Wilson Hemingway Lieutenant Commander, U.S. Navy	Cost Center Financial Management: Training the OPTAR Managers	199
Robert L. Henderson Lieutenant, U.S. Navy	An Analysis of the State of Total Quality in Academia	199
Patrick J. Hennelly Lieutenant Commander, Supply Corps U.S. Navy	A Comparison of the Small and Disadvantaged Business Utilization Specialists (SADBUSs) Role at Naval Regional Contracting Center (NRCC) Philadelphia, PA and Naval Regional Contracting Center (NRCC) San Diego, CA Detachment Long Beach	200
Wanda F. Hereford Lieutenant, U.S. Navy	Military Retirees and Their Perceived Health Care Needs	200
Caroline Margaret Hillen Lieutenant, U.S. Navy	Learning Obectives for Entry-Level Department of the Navy Accounting Technicians (GS-525 Series)	200
Brian Edward Hinkley Lieutenant, U.S. Navy	Costs of Operation Desert Shield/Desert Storm: A Burden Sharing Perspective	201
Heidi H. Holfert Lieutenant, U.S. Navy	Learning Objectives for Department of the Navy Entry-Level Budget Analysts (Series GS-560)	201
David James Holmgren Lieutenant, U.S. Navy	Naval New Ship Construction Cost Analysis and Trends	202
Eric M. Huffman Captain, U.S. Army	An Analysis of the Army Acquisition Corps	202
Michael D. Huggins Lieutenant, Civil Engineer Corps, U.S. Navy and Carlos D. Buzon, II Lieutenant, Supply Corps, U.S. Navy	Cost/Benefit Analysis of Commander, Naval Surface Force, U.S. Pacific Fleet's, Supply Maintenance Training Team	203
Roger Prescott Jackson Lieutenant Commander, U.S. Naval Reserve	A Comparison of the Financial Management Curriculum at the Naval Postgraduate School and other Graduate Public Financial Management Curricula in the United States	203

Robert Lawrence Jacobs Lieutenant, Supply Corps U.S. Navy and Robert Michael Dryer Lieutenant, Supply Corps U.S. Navy	A Preliminary Simulation Model for the Advanced Traceability and Control (ATAC) System	204
J. Andrew Johnson Lieutenant Commander, U.S. Navy	Cost Estimates for Desert Shield/Desert Storm: A Budgetary Analysis	204
Martin E. Jolly Lieutenant, U.S. Navy	Video Teleconferencing Feasibility Study at the Naval Postgraduate School	205
Susan Sturm Jordan Lieutenant Commander, U.S. Navy	An Analysis of the Impact of Graduate Education on the Performance and Retention of General Unrestricted Line Officers	205
Tod Norman Jordan Captain, U.S. Army	The Limits and Possibilities of Decision Models for Army Research and Development Project Selection	206
Gary W. Kertz Lieutenant Commander, U.S. Navy	Role of the Inland Waterways Systems During Mobilization	206
Byung Goo Kim Major, ROK Army	An Analysis of Reenlistment Intention and Actual Reenlistment of Army Second-Term Enlisted Personnel	207
Young Suk Kim Lieutenant, ROK Navy	Regression Analysis of Demand for U.S. Military Labor	207
William Harold Kindred	Budgeting for Test and Evaluation in the Department of the Navy	208
John Gerald Kinney Lieutenant, U.S. Navy	Analysis of P-3 Aircrew Coordination Training	208
Mark G. Klenzman Lieutenant, Supply Corps U.S. Navy	Analysis of the Navy's Use of Rail Transportation	208
Ellen M. Klotz	The Fuze Industrial Base at Naval Air Warfare Center Weapons Division, China Lake, California	209
Edward L. Knighton, II Lieutenant Commander, U.S. Navy and Norbert F. Melnick Lieutenant, U.S. Navy	Applying Total Quality Leadership to an Aviation Squadron	209
Leonard Richard Kojm, Jr. Lieutenant, U.S. Navy	The Feasibility of Radio Frequency Identification in Logistics Applications	209
Scott J. Koster Captain, U.S. Marine Corps	Preparing for the Unexpected, Contracting in Contingency Situations	210

Donald J. Krentz **Lieutenant Commander, U.S. Navy**	**Analysis of Consolidating Naval Aviation Depots**	**210**
Yong Hak Lee **Major, ROK Army**	**Defense Industry and its Impacts on Economic Growth in Korea**	**211**
Harry Lehman, Jr. **Lieutenant Commander, U.S. Navy**	**Total Quality Management in Logistics: A Case Study from the Trucking Industry**	**211**
Bruce Neil Lemler **Lieutenant, Supply Corps,** **U.S. Navy**	**An Evaluation of the Application of the Cost Accounting Standards: A Case Study**	**211**
Guy Lescher Leopard, Jr. **Lieutenant, Supply Corps** **U.S. Navy**	**Aviation Consolidated Allowance List (AVCAL) Reduction Analysis**	**212**
Douglas W. Lessley **Captain, United States Army**	**Special Operations and the Soldier System: Critical Acquisition Issues**	**212**
Frank A. Lindell **Lieutenant, U.S. Navy**	**The Role of the Navy Comptroller in Managing the OMB Circular A-76 Process**	**212**
Brion William Loftus **Lieutenant, Supply Corps,** **U.S. Navy**	**Department of the Navy Field Contracting Activities' Contracting Efforts with the Federal Prison Industries, Inc.**	**213**
Mark D. Lumb **Captain, U.S. Army**	**An Examination of the Skills, Experience, Training and Education Requirements Needed as a Functional Area 97 Officer in the Army Acquisition Corps**	**213**
Jay Douglas Mahaffey **Lieutenant Commander,** **U.S. Coast Guard**	**The V-22 Tilt Rotor, a Comparison with Existing Coast Guard Aircraft**	**213**
David S. Malcolm **Major, U.S. Marine Corps**	**Parametric Cost Estimation Utilizing Development-to-Production Relationship Applied to the Advanced Amphibious Assault Vehicle**	**214**
Anthony F. Marinello **Lieutenant, Supply Corps** **U.S. Naval Reserve** **and Ben A Fegurgur** **Lieutenant Commander,** **Supply Corps U.S. Navy**	**Potential Impact of the Elimination of the M Account on the Department of the Navy**	**214**
Daniel Thomas Martin **Commander, U.S. Naval Reserve**	**New Developments in Financial Management in Armed Forces**	**214**

Richard Charles Mazza **Lieutenant Commander,** **U.S. Naval Reserve**	**Naval Reserve: An Organization in Transition**	**215**
Yolanda Edricka McCarden **Lieutenant, U.S. Navy**	**Base Closure and Health Coverage: The Case of *Silas B. Hays Army Community Hospital* and Fort Ord**	**215**
Laurie A. McKee **Lieutenant Commander, U.S. Navy**	**A Comparataive Study of Government and Non-Government Ethics Programs, Practices and Policies**	**216**
William Clinton McQuilkin **Lieutenant, U.S. Navy**	**An Analysis of the Navy's Permanent Change of Station Planning Process and Move Forecasting Models**	**216**
Norbert F. Melnick **Lieutenant, U.S. Navy** **and Edward L. Knighton, II** **Lieutenant Commander, U.S. Navy**	**Applying Total Quality Leadership to an Aviation Squadron**	**217**
Cherlynn Emma Moes **Lieutenant, U.S. Naval Reserve**	**The Most Efficient Organization: A Strategic Issue Management Case Study**	**217**
Kathy Reading Moore **Lieutenant Commander,** **U.S. Naval Reserve**	**Budget Reform and the Budget Enforcement Act of 1990**	**217**
Ellen E. Moreau **Lieutenant, U.S. Navy**	**Forecasting High-Tech ASVAB Scores**	**218**
Robert James Morrison, Jr. **Lieutenant Commander,** **U.S. Coast Guard**	**Collateral Duty Job Satisfaction Among Coast Guard Aviators**	**218**
Marc Thomas Nicolls **Captain, U.S. Marine Corps**	**Resistance to Total Quality Leadership Change: An Evaluation of Individual Marine Responses to TQL Principles and Change**	**219**
Donald Bert Nuckols, Jr. **Lieutenant, U.S. Navy**	**Factors Affecting Post-Service Wage Growth for Veterans**	**219**
Mark A. O'Brien **Lieutenant Commander,** **Royal Australian Navy**	**The V-22 Osprey: A Case Analysis**	**219**
Matthew Gerard Ochs **Captain, U.S. Marine Corps**	**An Analysis of Navy, Marine Corps, and *Army Food Service Contracting***	**220**
Walter E. Owen **Lieutenant Commander, U.S. Navy**	**Navy and Marine Corps Industrial Activities; a Guide for the Comptroller**	**220**

Magno O. Pasadilla, Jr Lieutenant, U.S. Navy and Dennis K. Christensen Lieutenant Commander, U.S. Navy	The Design of a Prototype Personal Computer Database for the Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS)	221
Janet Johnson Patton	Managing the Contract Closeout Process	221
Norman Lance Peters Captain, U.S. Marine Corps	Parametric Cost Estimation for Amphibious Assault Vehicle's Life Cycle Costs	222
Kim G. Pinkerton Lieutenant Commander, Supply Corps U.S. Navy	A Comparison of Alternative Methods of Obtaining Defense Logistics Agency (DLA) Cognizance Spare Parts for Contractor Furnished Equipment (CFE) During Initial Outfitting of New Construction U.S. Navy Ships	222
Margaret E. Pinkerton Lieutenant Commander, U.S. Navy	Planning, Programming and Budgeting for Training Conducted en Route Between Permanent Duty Stations: A Comparison of the Military Services	223
Robert E. Pottberg Lieutenant Commander, U.S. Navy	Identification of Barriers to More Effective Agricultural Water Managment in the Salinas River Valley	223
John Joseph Prendergast Lieutenant Commander, Supply Corps U.S. Navy	Application of a Taxonomical Structure for Classifying Goods Procured by the Federal Government	224
Jeffrey W. Pritchard Lieutenant, Supply Corps U.S. Navy	The Advanced Traceability annd Control System Performance Data Analysis	224
Daniel J. Proulx Lieutenant, U.S. Navy	The Principal Problems with the Administration of Service Contracts at a Ship Repair Facility	224
Mark Robert Radice Lieutenant, U.S. Navy	The Defense Enterprise Program: A Managerial Assessment	225
Sheena L. Reed Lieutenant, U.S. Navy	Retention and Promotion Rates of Naval Female Officers	225
Jackie L. Rickman Major, U.S. Marine Corps	Predicting High Quality AFQT with Youth Attitude Tracking Study Data	226
Cynthia O. Ringwall Lieutenant, Civil Engineer Corps U.S. Navy	An Evaluation of DoD Unit Costing as a Control System	226
Russell G. Roe Lieutenant Commander, Supply Corps U.S. Navy	A Dictionary of Acquisition and Contracting Terms	226

W. Drew Rowlands **Lieutenant, U.S. Navy** **and Paul K. Augustine** **Captain, U.S. Marine Corps**	**Benefit/Cost Analysis of Interdwelling Noise Control in Multifamily Dwellings**	**227**
Rolando M. Santiago **Lieutenant, Supply Corps** **U.S. Navy**	**Reducing Supplier Oversight: An Analysis of Supplier Quality Assurance Practices used by Defense Contractors and Malcolm Baldrige National Quality Award Winners**	**227**
Neil E. Seiden **Lieutenant Commander,** **Supply Corps U.S. Navy**	**The DoD Unit Cost Initiative: A Navy Overview, Economic analysis, and Review of Base Operations Support Cost Allocation**	**228**
Jonathan Claude Sherman **Lieutenant Commander, Medical Service Corps, U.S. Navy**	**Planning for a Department of Defense Mail Service Pharmacy System**	**228**
James L. Shields **Lieutenant, U.S. Navy**	**Department of Defense Implementation of the Chief Financial Officer Act**	**229**
Mark L. Skidmore **Lieutenant, U.S. Navy**	**Incentives for Recruiters**	**229**
William Canady Small **Lieutenant, Supply Corps,** **U.S. Navy**	**A Decision Support Strategy for the Acquisition of CVN Q-COSAL Target Date Material**	**229**
Charles S. Smith **Lieutenant, Civil Engineer Corps, U.S. Navy**	**Contracting for Engineering and Design Services in the Environmental Restoration Field**	**230**
Michael Edward Stabile **Lieutenant Commander,** **Supply Corps U.S. Navy**	**An Examination of the Total Quality Management (TQM) Concept Given Current Federal/DoD Competition Initiatives**	**230**
Carl Stephen Staggs **Lieutenant Commander** **U.S. Navy**	**Aviation Depot Level Repairable Carcass Tracking and Billing: The Effect of the Price System on Budgeting and Flying Hour Cost Reporting**	**230**
James I. Stoops **Lieutenant, Supply Corps,** **U.S. Navy**	**Refining the Evaluation of International Codevelopment Programs**	**231**
Ernest L. Styron, Jr. **Lieutenant Commander, U.S. Navy** **and Robert R. Asselin** **Lieutenant Commander, U.S. Navy**	**Cost Benefit Analysis of General Services Administration's Proposed Relocation**	**231**

Ismail Hakki Sulucay **First Lieutenant,** **Turkish Army**	**Inflation Accounting Methods and Their Effectiveness**	**231**
Steven S. Sutz **Captain, U.S. Marine Corps**	**Sources and Consequences of Intrinsic Task Motivation in Engineers at the Naval Avionics Center**	**232**
Anthony W. Swain **Lieutenant, U.S. Navy**	**Cost Benefit Analysis of the Credit Card Program at the Naval Postgraduate School**	**232**
Betty E. Talley **Lieutenant, U.S. Navy** **and Karen J. Vigneron** **Lieutenant, U.S. Navy**	**Joint Operation Planning and Execution**	**233**
Glenn E. Terry **Lieutenant, U.S. Navy**	**A Regression Analysis for Unit Costing at NAVSUP Activities**	**233**
Murray L. Tiffany, III **Lieutenant Commander, U.S. Navy**	**The Naval Plant Representative Office Organization Transition into the Defense Contract Managment Command: Impacts on Customers**	**234**
R. Forrest Tucker **Lieutenant, Supply Corps,** **U.S. Navy**	**The Use of Life Cycle Costing for the Acquisition of Non-Major Systems at the Naval Regional Contracting Center, *Detachment, Long Beach, CA***	**234**
James M. Underkoffler **Lieutenant Commander,** **Supply Corps U.S. Navy**	**In-Plant Quality Evaluation (IQUE) After One Year: A Program Review**	**234**
Hans-Joachim Uslar **Lieutenant Commander,** **German Navy**	**A Prototypical Model for Estimating High Tech Navy Recruiting Markets**	**235**
Alexander Lewis Urrutia **Lieutenant Commander, U.S. Navy**	**Career Paths for Unrestricted Line Officers with the Financial Management Subspecialty**	**235**
Merrilly Yvette Wells Uva **Lieutenant, Supply Corps,** **U.S. Navy**	**An Expert System for Managing Storage Space Constraints Aboard United States Naval Vessels**	**236**
Karen J. Vigneron **Lieutenant, U.S. Navy** **and Betty E. Talley** **Lieutenant, U.S. Navy**	**Joint Operation Planning and Execution**	**236**
Jeffrey D. Voltz **Lieutenant, U.S. Navy**	**Cost, Schedule, and Performance Tradeoffs in the Acquisition of Major Weapon Systems**	**237**

Michael Joseph Vormbrocke **Lieutenant, U.S. Navy**	**An Analysis of the Relationship between the Financial Condition of Major Defense Contractors and DoD Spending**	**237**
Jon M. Watson **Lieutenant Commander,** **U.S. Coast Guard**	**Reasons for OMB Circular A-76 Contract Cost Increases for U.S. Coast Guard Activities and Perceptions of the USCG A-76 Program**	**238**
Patrick R. Wenn **Lieutenant Commander,** **U.S. Naval Reserve**	**Morale, Welfare and Recreation: A Financial Management Guide for the Field Activity Comptroller**	**238**
Stephen G. West **Lieutenant, U.S. Navy**	**An Analysis of the Role of the Budget Committees in the Congressional Budget Process**	**239**
Mark Everal Whitson **Lieutenant Commander, U.S. Navy**	**An Investigation into Improving Non-NPL Cleanup Process**	**239**
David Wiley Williams **Lieutenant, U.S. Coast Guard Reserve**	**A Guide for Implementing Total Quality Management in the U.S. Coast Guard Reserve**	**239**
Harvey B. Williams, III **Major, U.S. Marine Corps**	**An Analysis of Selected United States Marine Corps Contracts Involving Minority Owned Small Businesses**	**240**
James Roger Wilson **Lieutenant, U.S. Navy**	**Postgraduate Education and Professional Military Development: Are They Compatible?**	**240**
James William Wirwille, Jr. **Lieutenant Commander, U.S. Navy** **and William Thomas Ainsworth** **Lieutenant, U.S. Navy**	**Analysis of a Proposal to Consolidate Aircraft Intermediate Maintenance Capabilities**	**241**

MECHANICAL ENGINEERING

Frank A. Arata **Lieutenant, U.S. Navy**	**Nucleate Boiling Heat Transfer Study of Direct Immersion Cooling of a 3x3 Array of Vertically Orientated Electronic Components in a Dielectric Liquid**	**245**
Erol Babiloglu **Lieutenant Junior Grade** **Turkish Navy**	**A Numerical Study of Dynamic Crack Propagation in Composites**	**245**
Fredric Gerard Bahrke **Lieutenant, U.S. Navy**	**On-Line Identification of the Speed, Steering and Diving Response Parameters of an Autonomous Underwater Vehicle from Experimental Data**	**245**
Philip G. Beierl **Lieutenant Commander, U.S. Navy**	**Finite Memory Model for Haptic Recognition**	**246**

John K. Bergersen **Lieutenant Commander, U.S. Navy**	**Effect of Surface Coating on Cylinders Subjected to Underwater Shock**	**246**
Scott D. Bohman **Lieutenant, U.S. Navy**	**Thermomechanical Processing of Aluminum Alloy 2519 for Grain Refinement and Superplasticity**	**246**
Luis A. Boticario **Lieutenant, U.S. Navy**	**Dynamic Response of Cylindrical Shells to Underwater End-On Explosion**	**247**
James F. Buckley, II **Lieutenant, U.S. Navy**	**The Deformation Characteristics and Micro-Structural Dynamics of an AL-10MG-0.1ZR Alloy**	**247**
Henry A. Castillo, Jr. **Lieutenant, U.S. Navy**	**Optimum Design of Isotropic Monocoque and Ring-Stiffened Circular Cylindrical Shells Subject to External Hydrostatic Pressure**	**247**
James W. Coleman **Lieutenant, U.S. Navy**	**Optimum Design of Experiments in Composite Reliability**	**248**
John [illegible] Cooper **Lieutenant, U.S. Navy**	**Process-Dependence of Properties in High Thermal Conductivity Aluminum Nitride Substrates for Electronic Packaging**	**248**
Randall Dean Corbell **Lieutenant, U.S. Navy**	**Shock Qualification of Combat Systems Equipment using Tuned Mounting Fixtures on the U.S. Navy Mediumweight Shock Machine**	**248**
David F. Eastwood, Jr. **Lieutenant, U.S. Navy**	**The Effect of Secondary Thermomechanical Processing Parameters on the Ambient Temperature Behavior of 10% Volume 6061 Al-Alumina Metal Matrix Composite**	**249**
Ronald L. Edwards **Lieutenant Commander, U.S. Navy**	**Optimum Pose Measurements for Kinematic Parameters Identification**	**249**
John Gilbert Esarey **Lieutenant, U.S. Navy**	**Continuous Measurement by Eddy Current Methods of Age Hardening in an Aluminum Alloy**	**250**
Padraic K. Fox **Lieutenant Commander, U.S. Navy**	**Nonlinear Dynamic Response of Cylindrical Shells Subjected to Underwater Side-On Explosions**	**250**
Hsu-Sheng Fu **Lieutenant, ROC Navy**	**Optimal Stochastic Sliding Mode Control of Underway Replenishment in a Random Sea**	**250**
David R. Gordon **Lieutenant Commander, U.S. Navy**	**Computational Unsteady Flow Dynamics: Oscillating Flow about a Circular Cylinder**	**251**
Joseph D. Guido **Lieutenant Commander, U.S. Navy**	**Experimental Development of Tubeside Heat Transfer Correlations for Laminar Flow with and without Inserts**	**251**

Russell E. Haas Lieutenant, U.S. Navy	Nucleate Pool Boiling Performance of R-114/Oil Mixtures in a Small Enhanced Tube Bundle	252
Christopher N. Hickey Lieutenant, U.S. Navy	Natural Convection from a Horizontal Heater in Response to Steady and Pulsatile Input Powers	252
Stephen Mark Jackson Lieutenant, U.S. Navy	Heat Transfer, Adiabatic Effectiveness and Injectant Distributions Downstream of Single Rows and Two Staggered Rows of Film-Cooling Holes with Simple and Compound Angles	252
Konstandinos G. Kondos Lieutenant Junior Grade Hellenic Navy	X-ray Diffraction and Electron Microscope Studies of Yttria Stabilized Zirconia (YSZ) Ceramic Coatings Exposed to Vanadia	253
Lannie R. Lake Lieutenant Commander, U.S. Navy	The Influence of a Lower Heated Tube on Nucleate Pool Boiling from a Horizontal Tube	253
Stephen Larsen Lieutenant, U.S. Navy	Effects of Power Pulsations on Natural Convection from Discrete Heat Sources	253
Mary J. Logsdon Lieutenant, U.S. Navy	Coupled Roll and Directional Stability Characteristics of Surface Ships	254
John Edwin Lotshaw, Jr. Lieutenant Commander, U.S. Navy	Numerical Analysis of Oscillating Flow about a Circular Cylinder	254
Peter C. Lyle Lieutenant, U.S. Navy	Correlation of Processing, Microstructure and Superplasticity in an Al-Mg-Zr Alloy	254
Mark S. Manfredi Lieutenant, U.S. Navy	Computer Simulation of Random and Non-Random Second-Phase Particle Distributions for both Constant and Varying Particle Size	255
Wayne Joseph Mathe Lieutenant, U.S. Navy	Precipitate Coarsening During Overaging of 2519 Al-Cu Alloy: Application to Superplastic Processing	255
Scott T. Matthews Lieutenant, U.S. Navy	Natural Convection Immersion Cooling of an Array of Vertically Oriented Heated Protrusions in an Enclosure Filled with a Dielectric Liquid: Effects of Enclosure Width, Prandtl Number and Component Orientation	256
Christopher William May Lieutenant, U.S. Navy	Effect of Thermomechanical Treatments on the Aging Response of Centrifugally Cast Silicon Carbide/Aluminum Composites	256

Robert Walter Mazzone **Lieutenant, U.S. Navy**	**Enhanced Condensation of R-113 on a Small Bundle of Horizontal Tubes**	**257**
Eugene Paul Mcdonald **Lieutenant, U.S. Navy**	**Microstructure and Mechanical Properties of Ultra Low Carbon Bainitic 100 Tungsten Inert Gas Multipass Weldments**	**257**
Paul Francis McHale **Lieutenant, U.S. Navy**	**Factors Influencing the Microstructural and Mechanical Properties of ULCB Steel Weldments**	**258**
Brian D. McKinley **Lieutenant, U.S. Navy**	**Dynamic Stability of Positively Buoyant Submersibles: Vertical Plane Solutions**	**258**
Margaret Anne Menzies **Lieutenant, U.S. Navy**	**Weight Optimum Arch Structures**	**259**
William Earl Miller, II **Lieutenant, U.S. Navy**	**Simulation of the Underwater Nuclear Explosion and its Effects**	**259**
Juan A. Navarrete, III **Lieutenant, U.S. Navy**	**Neural Network Based Propulsion System Fault Diagnostics for the NPS AUV II**	**259**
Kurt W. Nelson **Lieutenant Commander, U.S. Navy**	**Dynamic Response and Failure Analysis of Aluminum Cylinders Subjected to Underwater Explosion**	**260**
Francis Gerard Novak **Lieutenant, U.S. Navy**	**A Correlation of Welding Solidification Parameters with Weld Macrostructure**	**260**
Thomas Joseph O'Keefe **Lieutenant, U.S. Navy**	**Filmwise Condensation of Steam on Horizontal Wire-Wrapped Smooth and Roped Titanium Tubes**	**260**
Geraldine Louise Olson **Lieutenant, U.S. Navy**	**Optimization of an Internally Finned Rotating Heat Pipe**	**261**
Timothy John Panoff **Lieutenant, U.S. Navy**	**Reference Path Generation and Tracking of Marine Vehicles**	**261**
Anthony Eldorado Ramsey **Lieutenant, U.S. Navy**	**A Study of Film Cooling Downstream of One and Two Rows of Holes Oriented in Spanwise/Normal Planes**	**261**
Stephen A. Rogers **Captain, U.S. Army**	**The Role of Particles in Recrystallization of a Thermomechanically Processed Al-Mg Alloy**	**262**
Andrei Sapsai, Jr. **Lieutenant, U.S. Navy**	**Temperature Distribution and Thermally Induced Stresses in Electronic Packaging**	**262**
Thomas J. Schauder **Lieutenant, U.S. Navy**	**The Effects of Thermomechanical Processing Parameters on Elevated-Temperature Behavior of a 6061 Al-Al_2O_3 Metal Matrix Composite**	**263**

Peter Edward Schupp **Lieutenant, U.S. Navy**	**Flow Visulaization Studies of Geometric Effects on Weld Pool Stirring in Gas Tungsten Arc Welds**	**263**
John S. Sedlak **Lieutenant Commander, U.S. Coast Guard**	**Microstructure-Cryogenic Behavior Correlations in Al-Cu-Li Alloys**	**264**
Metin Serttunc **Lieutenant Junior Grade Turkish Navy**	**Effects of Interfacial Debonding and Fiber Breakage on Static and Dynamic Buckling of Fibers Embedded in Matrices**	**264**
Dimitrios A. Simakis **Lieutenant, Hellenic Navy**	**Vehicle Guidance and Control Along Circular Trajectories**	**265**
Scott G. Spooner **Lieutenant, U.S. Navy**	**An Energy Analysis of the Pseudo Wigner-Ville Distribution in Support of Machinery Monitoring and Diagnostics**	**265**
Troy A. Stoner **Lieutenant, U.S. Navy**	**Preparation of Extinction Free γ Ti-51at.%Al Alloy Powder and Characterization by X-Ray Diffraction**	**265**
William E. Swayze **Lieutenant, U.S. Navy**	**Modelling Experimental Procedures for Manipulator Calibration**	**266**
Keith Andrew Swensen **Lieutenant, U.S. Navy**	**Further Studies in Filmwise Condensation of Steam on Horizontal Finned Tubes**	**266**
James Dale Syring **Lieutenant, U.S. Navy**	**Mixed and Forced Convection from an Array of Discrete Heat Sources in a Vertical Channel**	**266**
James M. Syvertsen **Lieutenant, U.S. Navy**	**Force Override Rate Controller for Remote Actuation**	**267**
Ronald G. Thompson, Jr. **Lieutenant Commander, U.S. Navy**	**Natural Convection Heat Transfer Studies of Simulated and Actual Electronic Components using Dielectric Liquids for Immersion Cooling**	**267**
Kenneth J. Thorkildsen **Lieutenant, U.S. Coast Guard**	**Numerical Field Model Simulation of Fire and Heat Transfer in a Rectangular Compartment**	**267**
Emmanuel Tsourdalakis **Lieutenant, Hellenic Navy**	**Phase Transformation in Ti_3Al Based Alloy**	**268**
Daniel Victor Venne **Lieutenant, U.S. Coast Guard**	**Effects of Positional Information Time Lags on Motion Stability of Autonomous Vehicles**	**268**

David C. Warner **Commander, U.S. Navy**	**Design, Simulation, and Experimental Verification of a Computer Model and Enhanced Position Estimator for the NPS AUV II**	**269**
Anthony D. Wiest **Lieutenant, U.S. Coast Guard**	**Thermal Cycling Behavior of Unidirectional and Cross-Plied P100 Gr/6061 Aluminum Composites**	**269**
James Michael Wigle **Lieutenant Commander, U.S. Navy**	**Heat Transfer, Adiabatic Effectiveness and Injectant Distributions Downstream of Single and Double Rows of Film-Cooling Holes with Compound Angles**	**269**
Thomas James Williamson **Lieutenant, U.S. Navy**	**Weight Optimum Arch Structures**	**270**
Harvey Allen Winters **Lieutenant, U.S. Navy**	**A Study of the Microstructural Basis for the Strength and Toughness Properties of As-Quenched and Quenched and Tempered High Copper HSLA-100 Steel**	**270**

METEOROLOGY

Christopher K. Brooks **Captain, U.S. Air Force**	**Multispectral Analysis of Maritime Clouds at Night in the Presence of Atmospheric Water Vapor**	**273**
Tzyh-Chyang Yin **Lieutenant Commander, ROC Navy**	**Tests of a Convective Cloud Model with Soundings during the TCM-90 Field Experiment**	**273**

METEOROLOGY AND PHYSICAL OCEANOGRAPHY

Christopher L. Abbott **Lieutenant, U.S. Navy**	**Observations of Wind Forced Circulation on the Continental Shelf off Point Sur, California from a Self-Contained Acoustic Doppler Current Profiler**	**277**
Michael Dean Angove **Lieutenant, U.S. Navy**	**Estimating Mesoscale, Orographically Enhanced Precipitation using Synoptic Scale Data**	**277**
Jacqueline M. Binhlam **Lieutenant, U.S. Navy**	**Examination of Three-Dimensional (3-D) Effects on Sound Propagation through Mesoscale Features using 3-D Coupled Mode Theory**	**278**
Richard Hugh Bohner, Jr **Lieutenant Commander, U.S. Navy**	**Definition of Mean Environmental Steering Flow for TCM-90 Tropical Cyclones**	**278**
Mary B. Clifford **Lieutenant, U.S. Navy**	**Effects of Water Vapor and Anisotropic Scattering on Aerosol Optical Depth Retrieval**	**279**

Patrick William Corkill **Lieutenant Commander, U.S. Navy**	**Synoptic and Mesoscale Factors Influencing Stratus and Fog in the Central California Coastal Region**	**279**
Alex Joseph DeCaria **Lieutenant, U.S. Navy**	**Multi-Fractal Analysis of Nocturnal Boundary Layer Time Series from the Boulder Atmospheric Observatory**	**279**
Michael Eugene Evans **Lieutenant, U.S. Navy**	**Analysis of Ships Tracks in Cloudiness Transition Regions**	**280**
Vincent F. Giampaolo **Lieutenant, U.S. Navy**	**Shiptrack Detection Algorithm Study**	**280**
Lawrence Joseph Gordon **Lieutenant Commander, U.S. Navy**	**Analysis of a Simulation of the Seasonal Cycle in the Tropical Pacific Ocean in an Eddy-Resolving Global Ocean Model**	**281**
Frank Joseph Grandau **Lieutenant Commander, U.S. Navy**	**Evaluation of the Naval Research Laboratory Limited Area Dynamical Weather Prediction Model: Topographic and Coastal Influences along the West Coast of the United States**	**281**
Bruce Robert Kitchen **Lieutenant Commander, U.S. Navy**	**The Effects of Mixed Layer Dynamics on Ice Growth in the Central Arctic**	**281**
TeriAnn Lentz **Lieutenant, U.S. Navy**	**Numerical Studies of the Beta-Effect in Tropical Cyclone Motion using a Semi-Lagrangian Model**	**282**
Anthony A. Martinez **Lieutenant Commander, U.S. Navy**	**High Frequency Analyses of Coastal Meteorological Phenomena Affecting Refractivity**	**282**
Robert W. Maxson **Lieutenant Commander, NOAA**	**Comparison of Areal Extent of Snow as Determined by AVHRR and SSM/I Satellite Imagery**	**283**
David Hilton McCarren **Lieutenant Commander, U.S. Navy**	**Analysis of Drifting SOFAR Buoys in the Greenland Sea 1989-1990**	**283**
Brian Herbert Miller **Lieutenant, U.S. Navy**	**Improved Aerosol Optical Depth and Particle Size Index from Satellite Detected Radiance**	**284**
William Peter Morgan **Lieutenant Commander, U.S. Navy**	**Satellite Detection of Complex Aerosols over the Arabian Peninsula/Gulf**	**284**
James M. Olson **Lieutenant Commander, U.S. Navy**	**Conditional Instabilities of the Greenland Sea**	**285**
James C. Pettigrew **Lieutenant, U.S. Navy**	**Surface Meteorological Parameters of Identified Ship Tracks**	**285**

Jeff Harrison Rucker **Lieutenant, U.S. Navy**	**Upper-Tropospheric Forcing of the Intensification Rates of Tropical Cyclones Flo and Ed Based on TCM-90 Observations**	**285**
Gregory Salvato **Lieutenant, U.S. Navy**	**Comparison between Arctic and Subtropic Ship Exhaust Effects on Cloud Properties**	**286**
William J. Schulz, Jr. **Lieutenant, U.S. Navy**	**Wind Speed and Moisture Sensitivity Tests of the NRL Limited Area Dynamical Weather Prediction Model: An OSSE Study of ERICA IOP-4**	**286**
Paul C. Stewart **Lieutenant, U.S. Navy**	**Incorporation of a Radiation Parameterization Scheme into the Naval Research Laboratory Limited Area Dynamical Weather Prediction Model**	**286**
Eric Lex Westreich **Lieutenant, U.S. Navy**	**Modeling Pulse Transmission in the Monterey Bay using Parabolic Equation Methods**	**287**
William Archer Wright, III **Lieutenant, U.S. Navy**	**Applications of Passive Microwave Satellite Data for Arctic Sea Ice Studies**	**287**

NATIONAL SECURITY AFFAIRS

James Robert Blount **Lieutenant, U.S. Navy**	**The New World Order: Enduring Currents in American Foreign Policy**	**291**
Diane Elizabeth Burgess **Lieutenant, U.S. Navy**	**Multispectral Imagery: An Essential Tool for Today's Naval Operations**	**291**
Phillip C. Chudoba **Captain, U.S. Marine Corps**	**Blinding the Eyes of the Corps: Foresight at Last?**	**291**
Kimberly Ann Cochran **Lieutenant, U.S. Navy**	**Press Coverage of the Persian Gulf War: Historical Perspectives and Questions of Policy beyond the Shadow of Vietnam**	**292**
Diego R. Corral **and Richard H. Shirer, Jr.**	**Intelligence Database Support for Naval Arms Control**	**292**
Craig S. Faller **Lieutenant, U.S. Navy**	**The Navy and Jointness: No Longer Reluctant Partners?**	**293**
Michael William Gannon **Lieutenant, U.S. Navy**	**Cruise Missile Proliferation: An Application of Bayesian Analysis to Intelligence Forecasting**	**293**
Jayne E. Garland **Lieutenant Commander, U.S. Navy**	**Tunisia: Islam as a Political Force**	**293**
David Joseph Gellene **Lieutenant, U.S. Navy**	**Deterring Nuclear-Armed Third World Dictators: A Targeting Strategy for the Emerging Threat**	**294**

Peter T. Greenwald **Lieutenant, U.S. Navy**	**The United States and Environmental Security: Deforestation and Conflict in Southeast Asia**	**294**
Robert W. Hand **Captain, U.S. Army**	**Two Steps Forward, One Step Back: The Pattern of Russian Liberal Reforms and its Implications for Russia and the United States**	**295**
Roger G. Herbert, Jr. **Lieutenant, U.S. Navy**	**Bullets with Names: The Deadly Dilemma**	**295**
Mark M. Huber **Lieutenant, U.S. Navy**	**Legitimacy and Hafez al-Asad**	**295**
Brent Perry Jenkins **Lieutenant, U.S. Navy**	**United States Warship Transfers to Argentina, Brazil, and Chile: Optins for U.S. Policy**	**296**
Michael Wayne Jordan **Lieutenant, U.S. Navy**	**Soviet Antilanding Doctrine: Does it Matter?**	**296**
Richard L. Jordan **Lieutenant Commander, U.S. Navy**	**The Return of the "Good Neighbor": A Policy for Achieving U.S. Objectives in Latin America through the Nineties and Beyond?**	**296**
Roy Ian Kitchener **Lieutenant, U.S. Navy**	**The Brazilian Military: Its Role in Counter-Drug Activities**	**297**
Michael D. Kuszewski **Major, U.S. Marine Corps**	**Intelligence: A Personal, Inherent, Function of Command**	**297**
Jeffery L. LaCaze **Lieutenant, U.S. Navy**	**Russian-Japanese Accommodation: A Threat to America's Strategic Position in the Pacific?**	**297**
John William Little, Jr. **Lieutenant, U.S. Navy**	**Vietnam in U.S. Foreign Policy: An Association for the Strategic Balance in Southeast Asia**	**298**
Todd Webster Malloy **Lieutenant Commander, U.S. Navy**	**Why the United States should Negotiate a Ban on Naval Tactical Nuclear Weapons**	**298**
Victor Steven Malone **Lieutenant, U.S. Navy**	**German Security Policy: Continuity and Change**	**299**
Francis Xavier Martin **Lieutenant, U.S. Navy**	**The Guadalajara Accord between Brazil and Argentina: A Tentative Step Toward the Nuclear Weapons-Free Latin America Envisioned by the Treaty of Tlatelolco**	**299**
Brendan James McCall **Lieutenant, U.S. Navy** **and Mark Henry Werner** **Lieutenant, U.S. Navy**	**Back to the Future: The Role of the Founding Fathers in Shaping the New World Order**	**300**

Robert Edward Melton, Jr. **Captain, U.S. Air Force**	**Beyond the Warsaw Pact: Russian Foreign Policy in East Central Europe in the 1990s**	**300**
Anthony Michael Migliore **Lieutenant, U.S. Navy**	**The New European Order: Historical Perspectives and Prospects for an Italian Role**	**301**
Douglas W. Mikatarian **Lieutenant, U.S. Navy**	**West European Defense Identity: Implications for U.S. Security Policy**	**301**
Samuel David Mohs **Lieutenant, U.S. Navy**	**The Politics of Nuclear Weapons**	**301**
James A. Pierce **Lieutenant, U.S. Navy**	**Coalition War and Burden-Sharing: The President vs. the Congress**	**302**
Robert Wesley Poor **Lieutenant, U.S. Navy**	**The United States in United Nations Military Operations**	**302**
Edward Walter Rogers **Lieutenant, U.S. Navy**	**Burma on the Brink: Complications for U.S. Policy in Burma**	**302**
Shirley Elaine Roman **Lieutenant, U.S. Navy**	**The Future Status of Puerto Rico: Implications for U.S. Foreign Policy**	**303**
George Foster Schieck **Lieutenant, U.S. Navy**	**Chinese-Middle East Relations and their Implications for U.S. Policy**	**303**
Todd Richard Sears **Lieutenant, U.S. Navy**	**War as Art or Science: A Humanist Vision**	**304**
Bernadette M. Semple **Lieutenant, U.S. Navy**	**The China-Africa Connection: Implications for United States Foreign Policy**	**304**
Richard H. Shirer, Jr. **and Diego R. Corral**	**Intelligence Database Support for Naval Arms Control**	**305**
Scott Michael Stanley **Lieutenant, U.S. Navy**	**Assessing the Impact of "Reasonable Sufficiency" on the Structure and Missions of the Former Soviet Navy**	**305**
Mark J. Taylor **Commander, Royal Australian Navy**	**From Alliance to Acquaintance: The Australian-American Security Relationship**	**306**
Eradio Edward Uresti **Captain, U.S. Air Force**	**The Guns-for-Drugs Trade: Implications for U.S. Foreign Policy**	**306**
Joseph J. Valenzuela **Lieutenant, U.S. Navy**	**Non-Nuclear Deterrence in U.S. Strategic Policy: Incentives and Limitations**	**306**
William Charles Vogt **Major, U.S. Army**	**The Soviet Coup of August 1991: Why it Happened, and Why it was Doomed to Fail**	**307**

Michael Gordon Waldhauser **Lieutenant, U.S. Navy**	**Revolution and Reaction in Europe and their Effects on the International System**	307
Randall W. Waldrip **Commander, U.S. Navy**	**Verifying the Chemical Weapons Convention: The Case for a United Nations Verification Agency**	308
Duncan Hughitt Walker **Lieutenant, U.S. Navy**	**Buffer or Highway: Cyclical Patterns of Security Development in East Central Europe**	308
Mark Henry Werner **Lieutenant, U.S. Navy** **and Brendan James McCall** **Lieutenant, U.S. Navy**	**Back to the Future: The Role of the Founding Fathers in Shaping in the New World Order**	309
John L. Wolf **Major, U.S. Army**	**The Indo-Pakistani Nuclear Issue: A U.S. Policy Perspective**	309
William Jennings Young, Jr. **Lieutenant, U.S. Navy**	**Japan: Asian Peacekeeper of the 21st Century?**	310
Kurt William Ziebarth **Lieutenant, U.S. Navy**	**Civil-Military Relation in the Soviet Union: Poised for Conflict**	310

OPERATIONS RESEARCH

Zafer Mutlu Aktan **Lieutenant Junior Grade** **Turkish Navy**	**A Probabilistic Approach to ASW Deployment in Shallow Waters**	313
Giora Arbel **Chief Engineer,** **Israel Military Industries**	**Effectiveness and Cost-Effectiveness Evaluation of an Advanced Artillery Weapons System**	313
Shafqat Baig **Lieutenant Colonel** **Pakistan Army**	**Scheduling the Peacetime Rotation of Pakistan Army Units**	314
Eric R. Bechhoefer **Lieutenant, U.S. Naval Reserve**	**An Indicator of Message Quality for a Single Optical Sensor using a Template-Based Tracking Algorithm**	314
Joseph J. Beel **Lieutenant, U.S. Navy**	**Anti-UAV Defense for Ground Forces and Hypervelocity Rocket Lethality Models**	314
Douglas Allen Blakemore **Lieutenant, U.S. Coast Guard**	**Predicting Coast Guard Enlisted Attrition**	315
James Allan Bonomo **Lieutenant, U.S. Navy**	**A Framework for Incorporating Battlefield Purpose and Intelligence**	315

Richard A. Brown **Lieutenant, U.S. Navy**	**A Naval Shipyard Optimal Drydock Loading and Capacity Utilization Model**	**315**
Kevin J. Cavanaugh **Lieutenant Commander, U.S. Coast Guard**	**A Multilevel Approach to Minimal Cost Network Flows**	**316**
Robert J. Celski **Major, U.S. Army**	**Realignment of the U.S. Army Recruiting Command**	**316**
Thomas Mark Conlon **Lieutenant, U.S. Navy**	**DDG 51 Operational Evaluation: Measures of Workload from Combat Information Center Communication Patterns**	**316**
Thomas E. Dennison **Lieutenant, U.S. Navy**	**Fitting and Prediction Uncertainty for a Software Reliability Model**	**317**
James M. Doll **Captain, U.S. Marine Corps**	**An Optimal Allocation of Recruiter and Facilities in the 12th Marine Corps District**	**317**
Scott Francis Donahue **Captain, U.S. Army**	**An Optimization Model for Army Planning Programming**	**318**
Jeffrey S. Dunn **Lieutenant, U.S. Navy**	**Scheduling Underway Replenishment as a Generalized Orienteering Problem**	**318**
Mark Alan Ehlers **Lieutenant, U.S. Navy**	**Countering the Third World Mobile Short-Range Ballistic Missile Threat: An Integrated Approach**	**319**
Robert Allen Farmer **Lieutenant Commander, U.S. Coast Guard**	**Scheduling Coast Guard District Cutters**	**319**
Joseph A. Gembarski **Lieutenant, U.S. Navy**	**Use of Multiple Tracking Data in the Calibration of Short Baseline Arrays**	**320**
Russell Gottfried **Lieutenant, U.S. Navy**	**PACSIM: Using Simulation in Designing a Communications Satellite**	**320**
Edward J. Harrington **Lieutenant, U.S. Navy**	**A Real-Time Sharpening of NOGAPS Predictions of Mid-Latitude Central Pacific Cyclones**	**320**
James J. Henry, IV **Lieutenant, U.S. Navy**	**Department of Defense in the War on Drugs: An Optimization Model for Counter-Narcotics Assets**	**321**
James M. Judy **Captain, U.S. Army**	**An Intra-Theater Transportation System Simulation to Assist Logisticians in Transportation Resource Planning and Implementation**	**321**

Wolfgang Kofer **Captain, Army, Federal Armed Forces Germany**	**Decision Aid for Planning the Maintenance of Electronic Equipment in the German Army**	**322**
Robert W. Lamont **Major, U.S. Marine Corps**	**Direct Fire Synchronization**	**322**
Cameron Jay Lewis **Lieutenant, U.S. Coast Guard**	**An Examination of the Performance of a Natural Truncation Point and Acceptance Rule for a Curtailed Wald Sequential Sampling Plan with Bernoulli Parameters**	**323**
William John Lohr **Lieutenant, U.S. Navy**	**Modeling the Search for a Randomly Moving Target by a Patrolling Searcher**	**323**
Peter F. Long **Major, U.S. Marine Corps**	**Effect of Variables Independent of Performance on Promotion Rates to Major, Lieutenant Colonel, and Colonel in the Marine Corps**	**323**
Douglas J. MacKinnon **Lieutenant, U.S. Navy**	**A Forecasting Model for Procurement Administrative Lead Time**	**324**
Warren Anthony Mazanec **Lieutenant, U.S. Navy**	**Interactive Naval Gunfire Support Training**	**324**
Deidre Loreen McLay **Lieutenant, U.S. Navy**	**Performance Measures for U.S. Pacific Fleet Ship Intermediate Maintenance Activities**	**325**
Bernard F. Mimms, Jr **Captain, U.S. Marine Corps**	**An Object-Oriented Approach to Reliability and Quality Control Modeling of the Maintenance Effort for U.S. Marine Corps Ground Combat Equipment**	**325**
Joseph Francis Monaghan, Jr. **Captain, U.S. Marine Corps**	**Evaluation of Digital Communications using the Marine Corps Communications Architecture Analysis Model**	**326**
Michael S. Nelson **Captain, U.S. Army**	**Graphical Methods for Depicting Combat Units**	**326**
David W. Norman **Lieutenant, U.S. Navy**	**A Cost Estimation Study of Th-57 Upgrade Proposals**	**326**
Bambang Poernomo **Commander, Indonesian Navy**	**A Revised Lower Confidence Limit Procedure for the Reliability of Complex Quasi-Coherent Systems**	**327**
Patchara Pumpiched **Lieutenant Commander,**	**Sequential Estimation of Optimal Age Replacement Policies when Distribution of Lifetimes is Phase Type**	**327**
Grady H. Roby, Jr. **Major, U.S. Marine Corps**	**Brigade Automated Mission Assignment Model for Theater Level Simulation**	**327**

David W. Samples Captain, U.S. Marine Corps	United States Marine Corps Mobile Electric Power Optimization Model	328
William Duward Sanders Lieutenant, U.S. Navy	Development and Comparison of TACAMO Icon Design Formats	328
Michael S. Schaffer Lieutenant, Medical Service Corps U.S. Navy	Navy Obstetrics/Gynecology Physician Allocation Model	329
Scott Edward Shaw Captain, U.S. Marine Corps	An Object-Oriented Ship-to-Shore Movement Analysis Model (Cutter)	329
Jeffrey Mark Springer Lieutenant, U.S. Navy	An Interservice Comparison of Recruiting Efficiency using Data Envelopment Analysis (DEA)	329
Robert M. Stammer Lieutenant, U.S. Navy	A Database Approach to Aircraft Carrier Airplan Production	330
Steven Eastwood Strukel Captain, U.S. Army	Analysis of the Command and Control Network Model and Linkage Mechanism with Force Evaluation Models	330
William J. Tarantino Captain, U.S. Army	Modeling Closure of Army Materiel Command Installations: A Bi-Criteria Mixed Integer Programming Approach	330
Alfred Viana Captain, U.S. Army	A Comparison of Engagement Ranges from the M1A2 Early Users Test and Experimentation to the Janus(A) Combat *Simulation Model*	331
David Eugene Wallace Lieutenant, U.S. Navy	Analysis Tools for United States Air Force Sortie Optimization and Munitions Planning	331
John K. Wood Captain, U.S. Army	An Evaluation of Varying Distribution Policies for the Commander's Independent Thermal Viewer on U.S. Army Main Battle Tanks	332
Tzu-Li Wu Lieutenant, ROC Navy	Optimization Models for Underway Replenishment of a Dispersed Carrier Battle Group	332
David Ziemba Lieutenant Commander, U.S. Navy	Application of an Interactive Computer Model to Analyze the Distribution of U.S. Navy Warfare Specialists Among Generalist Billets	332

PHYSICAL OCEANOGRAPHY

Emanuel Ferreira Coelho Lieutenant, Portuguese Navy	Acoustic Sensing of Ocean Turbulence	335
Gregory David Crabtree Lieutenant, U.S. Navy	Computer Simulation of Acoustic Fluctuations Due to Finescale Temperature Perturbations Measured by Thermistor Chain	335

John Mark Elliott **Lieutenant Commander, U.S. Navy**	**Simulation of Acoustic Multipath Arrival Structure in the Barents Sea**	**336**
Feng-Yu Kuo **Commander, ROC Navy**	**Monthly Mean Time Series of Temperature and Salinity in Monterey Bay, 1951-1991**	**336**
Thomas D. McGowan **Lieutenant, U.S. Navy**	**Radiation Stress Spectral Transformation Across the Surf Zone**	**337**
Thomas C. Neal **Lieutenant, U.S. Navy**	**Analysis of Monterey Bay CODAR-Derived Surface Currents, March to May 1992**	**337**
Hiroyuki Ogawa **Lieutenant Commnader, Japan Maritime Self-Defence Force**	**Testing the Accuracy of a Three-Dimensional Acoustic Coupled Mode Model**	**338**
Leo H. Ostwald, Jr. **Lieutenant, U.S. Navy**	**Predicting the Underwater Sound of Moderate and Heavy Rainfall from Laboratory Measurements of Radiation from Single Large Raindrops**	**338**
Robert S. Steadley **Lieutenant, U.S. Navy**	**Thermodynamic Air/Ocean Feedback Mechanisms in the Equatorial Pacific**	**339**

PHYSICS

Mary L. Atchley	**Observations of Breather Solitons in a Nonlinear Vibratory Lattice**	**343**
Carl A. Bice **Lieutenant, U.S. Navy**	**Theory for the CEBAF and Shipboard FELS**	**343**
Peter Gerard Braccio **Lieutenant, U.S. Navy**	**Survey of Trapped Plasmas at the Earth's Magnetic Equator**	**344**
Darwin L. Clark **Lieutenant, U.S. Navy**	**Theory for the CEBAF Infrared and Shipboard FELS**	**344**
David Franklin Davidson **Lieutenant, U.S. Navy**	**Radiation Surveys of the Naval Postgraduate School LINAC**	**345**
Charles A. Davis **Lieutenant, U.S. Navy**	**Magnetic Fields Generated by Internal Ocean Seawater Motion**	**345**
Scott Richard Evertson **Lieutenant, U.S. Navy**	**Experimental Considerations of Higher Order Parametric X-Rays from Silicon Crystals of Varying Thicknesses**	**346**
David J. Frost **Lieutenant Commander, U.S. Navy**	**Theory for a High Power Free Electron Laser and Tactical Applications**	**346**

Dean Alan Gant **Captain, U.S. Army**	**Comparison of Alkali Ion Emitters**	**346**
Bernard M. Gately, Jr. **Lieutenant, U.S. Navy**	**A Theory for Whistler Wave Amplification and Wave Particle Interaction in the Magnetosphere**	**347**
Cloyes R. Hoover **Lieutenant, U.S. Navy**	**Investigations of a Single Point Temperature Probe for Measurement of Atmospheric Turbulence**	**347**
Korey V. Jackson **Major, U.S. Army**	**The Use of Chaos Metrics to Analyze Lagrangian Particle Diffusion Models**	**348**
John Dietrick Lamade, II **Lieutenant, U.S. Navy**	**Investigation of an Argon-Filled Thermoacoustic Prime Mover**	**348**
Timothy Scott Mattingly **Lieutenant, U.S. Naval Reserve**	**Measurement of Surface Layer Optical Turbulence above AMOS**	**349**
Charles B. McClelland **Captain, U.S. Marine Corps**	**Kink-assisted Mode Hopping in a Surface Wave Resonator**	**349**
Michael Edward Melvin **Lieutenant Commander, U.S. Navy**	**Design and Evaluation of Ion Source for Satellite Charge Control**	**350**
Michael James Osborne **Lieutenant, U.S. Navy**	**Higher Order Parametric X-Rays**	**350**
Gary Raymond Parriott **Lieutenant, U.S. Navy**	**Development and Testing of a Prototype Electro-Optical Phase Encoded Position Transducer**	**351**
William J. Rall **Lieutenant, U.S. Coast Guard**	**Investigation of a CCD Camera for Measurements of Optical Atmoshpheric Turbulence**	**351**
Lewis J. Scott **Lieutenant, U.S. Navy**	**On the Consequences of Bi-Maxwellian Distributions on Parallel Electric Fields**	**352**
Donald S. Smith **Captain, U.S. Marine Corps**	**Investigation of Deep Dielectric Charging and Subsequent Currents on Geosynchronous Spacecraft**	**352**
Christopher B. Thomas **Lieutenant, U.S. Navy**	**Plasma Interactions in a Plasma Erosion Opeining Switch**	**352**
Paul Matthew Votruba **Lieutenant, U.S. Navy**	**Focusing X-Ray Transition Radiation with Cylindrical and Elliptical Optics**	**353**
Billie Sue Walden **Lieutenant, U.S. Navy**	**An Analysis of Middle Ultraviolet Dayglow Spectra**	**353**
Stephen Michael Wallace **Lieutenant, U.S. Navy**	**Magnetic Field Measurements of the CEBAF (NIST) Wiggler using the Pulsed Wire Method**	**354**

David S. Welsh Lieutenant, U.S. Navy	Current Density Limitations in a Fast-Pulsed High-Voltage Vacuum Diode	354
Richard N. Yaw Captain, U.S. Army	Monte Carlo Analysis of Energy Deposition in Solid State Materials by 400 and 200 MEV Electrons	355

SYSTEM ENGINEERINNG

Eugenia L. Cairns-McFeeters Lieutenant, U.S. Navy	Effects of Surface-Based Ducts on Electromagnetic Systems	359
Tzu-Chiang Chang Captain, ROC Army	Static Scheduler for Hard Real-Time Tasks on Multiprocessor Systems	359
Yoon Kyu Chi Lieutenant Colonel ROK Air Force	Evaluation of Radar Performance Degradation due to Standoff Jamming	359
Raghuram Devalla Scientist, DoD India	Design and Implementation of a Group Membership Protocol	360
Chen-Kuo Li Lieutenant Commander	An/SLQ-32 EW System Model: An Expandable Object-Oriented, Process-Based Simulation	360
John Michael Mackin Lieutenant, U.S. Navy	Automated Performance Evaluation Technique for Cryptologic Sites	361
Eric Brian Moss Lieutenant, U.S. Navy	Definition of the Sea Surface Infrared Sun Glitter Corridor	361
Amnauy Thongrod Lieutenant, Royal Thai Navy	Performance Evaluation of a Radar by Computer	362
Tsung-li Wu Captain, ROC Army	Distributed Processing on Link Enhancement	362

SYSTEMS TECHNOLOGY

Michael A. Cervi Captain, U.S. Air Force	Concepts and Issues for Systems Integration of U.S. Air Force Deployable Communications	365
James M. Child Captain, U.S. Air Force	A Hypertext Based Computer Architecture for the Joint Command, Control and Communications Curriculum	365
John Gordon Clarke Captain, U.S. Air Force	Introduction to Human Factors and Wide Area Networking	366

Kristen Ann Dotterway **Captain, U.S. Air Force**	**Systematic Analysis of Complex Dynamic Systems: The Case of the USS *Vincennes***	**366**
Marvin G. Fuller **Captain, U.S. Air Force**	**Technological Enhancements for Personal Computers**	**367**
Gilbert C. Gonzalez **Captain, U.S. Marine Corps** **and Edward A. Yeaste** **Lieutenant, U.S. Navy**	**USN/USMC Antiair Warfare and Command, Control, and Communications for Amphibious Operations**	**367**
Mark Joseph Gough **Lieutenant, U.S. Navy**	**The Effects of Team Leader Feedback on Situation Assessment in Distributed Anti-Air Warfare Teams**	**368**
Larry Allan Grant **Lieutenant, U.S. Navy**	**An Investigation of the Physical Characteristics of a Mass Element Resonator**	**368**
Jonathan David Inghram **Major, U.S. Marine Corps**	**Tactical Local Area Networks**	**369**
Bennett Karl Larson **Captain, U.S. Air Force**	**Resuable Ada Software for Command and Control Map Manipulation**	**369**
Wayne R. Martin **Captain, U.S. Air Force**	**C^3 Interoperability Issues: An Overview of GOSIP Network Conformance Testing in the Evolution of the Defense Information System *Network* (DISN)**	**370**
Lisa A. Norris **Captain, U.S Air Force**	**Modeling C3: The Effects of Information Delay in Tactical Tic-Tac-Toe (T4)**	**370**
Linda Maureen Sherfey **Lieutenant, U.S. Navy**	**Wargaming in Support of Command, Control and Communications Experiments**	**371**
Gordon George Roger Slifer **Captain, U.S. Army**	**Assessing the U.S Army's Combat Vehicle Command and Control System at the Battalion Level**	**371**
Edward A. Yeaste **Lieutenant, U.S. Navy** **and Gilbert C. Gonzalez** **Captain, U.S. Marine Corps**	**USN/USMC Antiair Warfare and Command, Control, and Communications for Amphibious Operations**	**372**

SYSTEMS TECHNOLOGY (COMMAND, CONTROL, AND COMMUNICATIONS)

Bryce Campbell **Lieutenant, U.S. Navy** **and Stephan Siletzky** **Lieutenant, U.S. Navy**	**Comparison of Electromagnetic Propagation Predictions from IREPS and RPO Across a Coastal Transition**	**375**

William G. Harrison, Jr. Lieutenant Commander, U.S. Navy	A Methodology for Assessing Acquisition Technical Risk	375
Joseph Howard Herbert Lieutenant, U.S. Navy	The Soviet Coup: A Command, Control, and Communications Analysis	376
Michael J. Sheehan Captain, U.S. Air Force	Selecting a Subset of Stimulus-Response Pairs with Maximal Transmitted Information	376
Stephan Siletzky Lieutenant, U.S. Navy and Bryce Campbell Lieutenant, U.S. Navy	Comparison of Electromagnetic Propagation Predictions from IREPS and RPO Across a Coastal Transition	377
Retha Ann Sueda	An Assessment of Accessibility to STU-III by Users with Disabilities	377
Darren L. Turner Lieutenant, U.S. Navy	Command and Control Architecture for Multi-National Operations	378
Dana Albert Williams Lieutenant, U.S. Navy	Feasibility of Meteor Burst Buoy Relay as a Command and Control Asset	378

SYSTEMS TECHNOLOGY (SPACE SYSTEMS OPERATIONS)

Robert Andrew Payne, Jr. Captain, U.S. Army	Applications of the Petite Amateur Navy Satellite (PANSAT)	381
Brook R. Roberts Lieutenant, U.S. Navy	Measuring NAVSPASUR Sensor Performance using Logistic Regression Models	381

TELECOMMUNICATIONS SYSTEMS MANAGEMENT

Rolando A. Apollo Lieutenant, U.S. Navy and Paul D. Bennett Captain, U.S. Marine Corps	The Development of an Information System Master Plan for the Pacific Missile Range Facility, Barking Sands, Hawaii	385
Joseph W. Beadles, III Lieutenant, U.S. Navy and Lee W. Schonenberg Lieutenant, U.S. Navy	Statistical Process Control Techniques for the Telecommunictions System Manager	385
Paul D. Bennett Captain, U.S. Marine Corps and Rolando A. Apollo Lieutenant, U.S. Navy	The Development of an Information System Master Plan for the Pacific Missile Range Facility, Barking Sands, Hawaii	386

Donna Doran Cannon **Lieutenant, U.S. Navy** **and Jan Fitzsimmons** **Lieutenant Commander, U.S. Navy**	**Base Information Transfer System (BITS)**	**386**
Nag Jung Choi **Captain, ROK Army**	**Multimedia Electronic Mail: Standards and Performance Simulation**	**387**
Rebecca Dell Dearborn **Lieutenant, U.S. Navy** **and Robert Cruz Morales** **Lieutenant, U.S. Navy**	**An Overview of the Copernicus C41 Architecture**	**387**
Guy Morgan Esten **Lieutenant Commander, U.S. Navy**	**National Airspace Data Interchange Network Analysis**	**388**
Jan Fitzsimmons **Lieutenant Commander, U.S. Navy** **and Donna Doran Cannon** **Lieutenant, U.S. Navy**	**Base Information Transfer System (BITS)**	**388**
Mark S. Foldy, Jr. **Lieutenant, U.S. Navy**	**P-3 Squadron Transition to the Defense Message System**	**389**
Mark A. Gates **Lieutenant, U.S. Navy**	**Survivability of Meteor Burst Communication under Adverse Operating Conditions**	**389**
Joseph E. Harkleroad **Lieutenant, U.S. Navy**	***A Case Study of Information Resource Management in the Department of Defense***	**389**
Hung-i Kuan **Commander, ROC Navy**	**Evaluation of a Biometric Keystroke Typing Dynamics Computer System**	**390**
John J. Lapke **Lieutenant Commander,** **U.S. Coast Guard**	**The Defense Message System and the U.S. Coast Guard**	**390**
Steven J. McGrath **Captain, U.S. Marine Corps**	**The Electromagnetic Pulse Environment and its Influence on Tactical Electronic and Communications Equipment**	**391**
Robert Cruz Morales **Lieutenant, U.S. Navy** **and Rebecca Dell Dearborn** **Lieutenant, U.S. Navy**	**An Overview of the Copernicus C41 Architecture**	**391**
Alice L. Rand **Lieutenant, U.S. Navy**	**The Communication Support System (CSS) and its Planning and Management upon Implementation**	**392**
Brian E. Riehm **Lieutenant Commander, U.S. Navy**	**FTS2000: Failed Incentives, Lessons Learned**	**392**

John W. Riley, III **Lieutenant Commander, U.S. Navy**	**Considerations for a Shipboard Multilevel Secure Local Area Network**	**392**
Lee W. Schonenberg **Lieutenant, U.S. Navy** **and Joseph W. Beadles, III** **Lieutenant, U.S. Navy**	**Statistical Process Control Techniques for the Telecommunications System Manager**	**393**
Thor A. Simensen **Lieutenant, U.S. Navy**	**Link-11 Communications**	**393**
Charles A. Worrell **Lieutenant, U.S. Navy**	**A Comparison of Alternative Transmission Paths for Administrative Data from Afloat Units**	**394**
Deborah E. Youngblood **Lieutenant, U.S. Navy**	**Implementing Total Quality Leadership in a Naval Computer and Telecommunications Activity**	**394**

DOCTOR
OF
PHILOSOPHY

MODELING AND CONTROL OF A TRAILING WIRE ANTENNA TOWED BY AN ORBITING AIRCRAFT

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Doctor of Philosophy in Aeronautical Engineering-September 1992
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A model of the dynamics of a long trailing-wire antenna towed behind an orbiting aircraft was developed and then an investigation was made of several candidate schemes to control the wire's steady-state shape and oscillations due to wind gradients. A computer simulation was developed using the classic vibrating chain with free/fixed boundary conditions superimposed upon the wire's steady-state shape and tension distribution. Several forms of restorative and dissipative forces were considered in the analysis. The validity of the superposition approach was demonstrated for a wide operating range. A control law was developed which modulated the towplane orbit radius and demonstrated a potential for a 50 percent or better reduction in all oscillations. A second scheme using a controllable drogue at the trailing end of the wire was investigated. The controllable drogue had a limited success in oscillation reduction, but was found useful in tailoring the steady-state shape of the wire.

IDENTIFICATION AND CONTROL OF NON-LINEAR TIME-VARYING DYNAMICAL SYSTEMS USING ARTIFICIAL NEURAL NETWORKS

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Identification and control of non-linear dynamical systems is a very complex task which requires new methods of approaching. This research addresses the problem of emulation and control via the use of distributed parallel processing, namely artificial neural networks. Four models for describing non-linear MIMO dynamical systems are presented. Based on these models a combined feedforward and recurrent neural networks are structured to emulate the dynamical system. Further, a procedure to emulate multiple systems in a single network is suggested. A method for finding a minimal realization of a network is introduced. The minimization greatly reduces the complexity of the network without degrading the operating performance of the network. This work also examines the application of artificial neural networks for adaptive control. The multiple-system approach is used to find an adaptive neural network controller for non-linear MIMO time-varying system in a direct model reference control scheme. The controller network is trained using a procedure called back-propagation through the plant, which was extended in this work. The application of neural networks is demonstrated on a longitudinal model of the F/A-18A fighter aircraft both with the undamaged aircraft and with a damage mechanism as a time-varying MIMO dynamical system.

A NUMERICAL, ANALYTICAL AND OBSERVATIONAL STUDY OF THE EFFECT OF CLOUDS ON SURFACE WIND AND WIND STRESS DURING THE CENTRAL ARCTIC WINTER

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Results of measurements from several Arctic field programs and numerical models show that clouds affect wind stress during the central Arctic winter by changing the longwave cooling of the surface and cloud layers. The longwave cooling alters the thermodynamic structure of the lower atmosphere which in turn affects the efficiency of momentum transfer to the surface. For typical Arctic conditions, wind stress is changed by about 40% one hour after a cloud condition change, due to changes in both the surface layer stability and surface layer wind speed. The actual wind stress effect due to clouds during this time is a function of wind speed, thermal wind, atmospheric boundary layer depth, magnitude of radiation change, snow age and, sometimes, snow depth. After several hours, surface heat fluxes are no longer important, but the structure of the atmosphere has been permanently altered. This affects the wind stress by about 10% to 20% during certain situations, but can vary depending on the initial atmospheric structure. Measurements of these effects show variations in wind stress associated with clouds. Operational and research studies of ice and ocean dynamics will benefit from consideration of cloud effects on wind stress.

INTELLIGENT INFORMATION RETRIEVAL FOR A MULTIMEDIA DATABASE USING CAPTIONS

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This report describes an intelligent information retrieval system, MARIE, that employs natural language processing techniques for indexing and retrieving multimedia data. Captions describe photographs from the Naval Air Warfare Center Weapons Division, China Lake, California; the captions were written in English consisting mostly of noun phrases. For our work, an object-oriented type hierarchy represents semantic knowledge. Captions are parsed to produce a logical form, from which nouns and verbs are extracted to form keyword files. User queries are also specified in natural language. A two-phase match process is employed between the query and database. A coarse-grain match searches the keyword files and issues SQL queries to a relational database as necessary to find candidate captions for further analysis. A fine-grain match then compares the logical form of the query to the logical form for each caption. A list of caption IDs and accompany match scores is then presented to the user, who can view the image and supporting data. A companion technical report contains the programs for the system discussed here.

RADAR DATA PROCESSING USING A DISTRIBUTED COMPUTATIONAL SYSTEM

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Doctor of Philosophy in Computer Science-June 1992
Advisors: Uno R. Kodres & Michael Nelson-Department of Computer Sciences

This research specifies and validates a new concurrent decomposition scheme, called Confined Space Search Decomposition (CSSD), to exploit parallelism of Radar Data Processing algorithms using a Distributed Computational System. To formalize the specification we propose and apply an object-oriented methodology called Decomposition Cost Evaluation Model (DCEM). To reduce the penalties of load imbalance we propose a distributed dynamic load balance heuristic called Object Reincarnation (OR). To validate the research we first compare our decomposition with an identified alternative using the proposed DCEM model and then develop a theoretical prediction of selected parameters. We also develop a simulation to check the Object Reincarnation concept.

REUSABLE SOFTWARE COMPONENT RETRIEVAL VIA NORMALIZED ALGEBRAIC SPECIFICATIONS

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Efforts in the software engineering community to reuse code are hampered by a lack of tools. Reusability is particularly beneficial in a rapid prototyping environment. Rapid prototyping with automated reusable software component retrieval is a software development method to rapidly construct and adapt software, validate and refine requirements, and check the consistency of proposed designs. This dissertation describes a tool used within the Computer Aided Prototyping System (CAPS), developed at the Naval Postgraduate School, which retrieves reusable components from a software base using a formal specification as the search key. The query specification that represents a design requirement is compared to formal specifications of Ada reusable software components stored in an object-oriented database management system. A syntactic search compares specification interfaces, identifying reusable candidates based on types of parameters. The semantic search rank orders a set of candidate components based on semantic similarity to the query. The method, called query by consistency, compares terms that are reduced in the axioms of each specification. Specifications are normalized to facilitate the matching between query specifications and reusable component specifications in the retrieval. A formal proof verifies that query by consistency can retrieve components guaranteed to meet specified requirements.

SOURCE LOCATION IN THIN PLATES USING CROSSCORRELATION

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Alternative methods to first threshold crossing techniques for acoustic emission (AE) source location in dispersive media are presented. The accuracy of source location in dispersive media can be improved by locating frequency components in the transducer outputs to determine the difference in arrival times. Two methods were developed in this study for the arrival time determination. The first involved crosscorrelating the transducer outputs with a cosine wave modulated by a Gaussian pulse to locate a single frequency in the outputs. The second method narrowband filtered the transducer outputs and then crosscorrelated the filtered signals to determine the difference in arrival times. The techniques were experimentally verified by performing lead breaks on the surface of aluminum and graphite/epoxy plates. The results indicate that accurate source location can be attained in dispersive media by taking the wave propagation into account.

AERONAUTICAL ENGINEER

APPLICATION OF NEURAL NETWORK TO ADAPTIVE CONTROL THEORY FOR SUPER-AUGMENTED AIRCRAFT

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B.E.E., Royal Military College of Kingston, 1985
Aeronautical Engineer-December 1991
Master of Science in Aeronautical Engineering-December 1991
Advisor: Daniel Collins-Department of Aeronautical Engineering

The neural network structures developed in this thesis demonstrate the ability of parallel distributed processing in solving adaptive control problems. Adaptive control theory implies a combination of a control method and a model estimation. The control method investigated is the Lyapunov Model Reference Adaptive Control or MRAC and the model estimation investigated is the linear least square estimator. The neural network theory is introduced with emphasis on the back-propagation algorithm. The implementation of the neural network adaptive control structure is demonstrated on the longitudinal dynamics of the X-29 fighter aircraft. Three configurations are proposed to train the neural network adaptive control structures to provide the appropriate inputs to the unstable X-29 plant so that desired responses could be obtained. These configurations are presented in eight cases, which emulates stable systems like the X-29 closed-loop plant or the optimal and the limited X-29 controllers, and unstable systems like the X-29 plant or its inverse.

A COMPUTATIONAL INVESTIGATION OF AIRFOIL STALL FLUTTER

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A fully factorized two-dimensional Navier-Stokes flow solver has been developed and applied to the problem of predicting subsonic airfoil flutter in the light stall regime. The inviscid fluxes are evaluated with a central difference ADI scheme and fourth and second order numerical dissipation is used to obtain oscillation-free solutions. The performance of algebraic and one-equation turbulence models in predicting separated flow is explored for computing high Reynolds number steady flow and unsteady flows over an oscillating NACA 0012 airfoil. Comparisons of the computed results with available experimental data indicate that even though the lift response is fairly well predicted, the computation of the pitching moment hysteresis loops is very sensitive to turbulence modeling. Results computed with several current models are in good agreement whenever the steady stall angle is exceeded only slightly. However, they fail to capture the vortex shedding process leading to the onset of stall flutter.

IMPLEMENTATION OF A PERSONAL COMPUTER BASED PARAMETER ESTIMATION PROGRAM

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Aeronautical Engineer-March 1992
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Aircraft parameter estimation is the process of extracting numerical values for aerodynamic stability and control derivatives from flight-test time history data. This process can be used as a verification or validation tool for results obtained from wind-tunnel testing or through computational analysis, and can obtain or improve estimations of dynamic derivatives. This study implements the MATLAB Personal Computer (PC) based maximum likelihood estimation routine for aircraft longitudinal and lateral-directional derivatives. The parameter estimation was first accomplished on generated simulated data, with and without noise. The noise consisted of measurement and state noise which used the Dryden Gust Model. Secondly, two actual longitudinal flight-test maneuvers are analyzed for the F-14A and the T-37 aircraft. Additionally, the simulated portion of this study can be an excellent instructional aid in Flight Dynamics and Flight Test Courses.

COMPUTER PROGRAM FOR CALCULATING IN-FLIGHT AIRCRAFT-STORE INTERFACE REACTION LOADS

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This thesis utilizes Military Specification, Mil-A-8591H, to provide and document a new computer program for calculating store reaction forces, due to inertial loads and airloads, at the aircraft-store interface. Due to the fact that the store is a statically indeterminate structure with unknown flexibility characteristics, the analysis to calculate the reaction forces is a relatively complex problem. The program was written to incorporate new requirements and techniques for calculating reaction loads at the aircraft-store interface in accordance with Mil-A-8591 revision H. This computer program was developed to be used on the VAX/VMS Computer System, Advanced Computational Laboratory, of the Aeronautics and Astronautics Department, Naval Postgraduate School. A detailed User's Manual which is included in Appendix A of this thesis was written to accompany the computer program. The computer program will enable graduate students in the Aircraft, Helicopter and Missile Design courses to utilize current military specifications for preliminary design and weapon system integration.

A COMPUTATIONAL AND EXPERIMENTAL INVESTIGATION OF THE PROPULSIVE AND LIFTING CHARACTERISTICS OF OSCILLATING AIRFOILS AND AIRFOIL COMBINATIONS IN INCOMPRESSIBLE FLOW

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Aeronautical Engineer-September 1992
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Computational and experimental methods have been used to systematically study one and two airfoils undergoing unsteady motion. First, a single airfoil analysis was done with the modified computer code, U2DIIF. Thrust, efficiency, and phase relationships were computed and compared to existing theoretical results. Furthermore, to help understand the dynamic stall process, relationships were developed between steady and quasi-steady pressure distributions for an airfoil undergoing a ramp motion. Next, an unsteady analysis for two airfoils was done with the modified computer code USPOTF2. Again, thrust and efficiencies for interfering, harmonically oscillating airfoils were computed and compared to existing theoretical results. Furthermore, an analysis was completed on the effects of a harmonically oscillating airfoil on the pressure gradient of a stationary airfoil. Finally, flow visualization experiments were conducted using a low speed smoke tunnel at the Naval Postgraduate School (NPS). This experiment demonstrated the effects of a thrust producing, oscillating airfoil on the formation of the wake vortices. Furthermore, a flow visualization experiment was conducted in the NPS low speed wind tunnel, which demonstrated the beneficial influence of a secondary airfoil oscillating in the vicinity of a stationary airfoil at high angle-of-attack.

A MULTI-FACETED ENGINEERING STUDY OF AERODYNAMIC ERRORS OF THE SERVICE AIRCRAFT INSTRUMENTATION PACKAGE (SAIP)

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Aeronautical Engineer-September 1992
Advisor: Oscar Biblarz-Department of Aeronautics and Astronautics

The general objectives of this research are to investigate, identify, and quantify the aerodynamic sources of altitude determination errors of the U.S. Navy's Service Aircraft Instrumentation Package (SAIP) and to make recommendations to remedy these errors. This multi-faceted study includes aero-panel methods, computational fluid dynamics (CFD), wind tunnel testing, and flight test evaluations. The Airflow Sensor Assembly (ASA), a device similar to a calibrated pitot static tube, was intended to meet the SAIP's required specifications for altitude determination. However, the ASA is housed in the five inch diameter body of the SAIP and mounted on a variety of host aircraft. The over-pressure generated by the SAIP body as well as the wing/pylon system engulf the static pressure ports creating altitude errors well out of performance limits. This over-pressure associated with these bodies was apparently not accounted for during design and acquisition and extensive modifications will be needed to offset or eliminate their effects.

AERONAUTICAL
AND
ASTRONAUTICAL ENGINEER

INVESTIGATION OF THE FLIGHT CONTROL REQUIREMENTS OF A HALF-SCALE DUCTED FAN UNMANNED AERIAL VEHICLE

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The goal of this investigation was to study the requirements to fly a previously constructed half-scale ducted fan Unmanned Aerial Vehicle (UAV) in horizontal and vertical flight as a proof of concept for a full scale UAV of similar design. The following items were investigated: (1) methods to increase thrust from the ducted fan propulsion system. (2) the determination of the effectiveness and necessary coupling of four control vanes in controlling the vehicle in vertical flight (pitch, roll, and yaw) and in countering the engine torque; (3) the design, construction, and effectiveness of stator vanes. The following items were accomplished: (1) thrust was improved over the original vehicle through the design and construction of an effective bellmouth and nine-bladed fan; (2) control vane effectiveness was determined, and stator vanes were designed and installed; (3) gyro stabilization was incorporated into the roll axis controls and the ducted fan flew in controlled tethered hover; and (4) gyroscopic cross-coupling was demonstrated.

EXPERIMENTAL VERIFICATION OF ATTITUDE CONTROL TECHNIQUES FOR FLEXIBLE SPACECRAFT SLEW MANEUVERS

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Aeronautical and Astronautical Engineer-March 1992
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The experimental verification of attitude control designs for flexible spacecraft is essential for reliable operation in space. The Flexible Spacecraft Simulator (FSS) at the Naval Postgraduate School is designed to test a variety of control designs. The experimental setup simulates pitch axis motion of a flexible spacecraft consisting of a rigid central body and a flexible appendage connecting a reflector. The primary acutators are a reaction wheel and thrusters. Angular position information is obtained with a rotary variable differential transformer (RVDT) and angular rate information is obtained by a solid state rate sensor. Two analytical models are derived: one based on cantilever modes, the other based on system modes. Both are the result of linearized equations of motion which assume small flexible displacements and rates. Slew maneuvers are conducted using four separate controllers. They are proportional-derivative (PD), torque profiles, bang-bang and optimal controllers. Techniques for state estimation are explored for the optimal controller since the standard estimation methods prove to be unsatisfactory. The sinusoidal torque profile delivers the best performance overall with the PD a close second. Momentum wheel desaturation with thrusters and thruster slew maneuvers are also performed. In all cases, experimental results are in close agreement with analytical predictions.

COMPUTATIONAL INVESTIGATIONS OF A NACA 0012 AIRFOIL IN LOW REYNOLDS NUMBER FLOWS

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Aeronautical and Astronautical Engineer-September 1992
Advisor: Max Platzer-Department of Aeronautics and Astronautics

A steady flow analysis is conducted for a NACA 0012 airfoil in low Reynolds number flows ranging from 540,000 to 1,000,000. Emphasis is placed on prediction and location of the separation bubble. Computational methods include the direct boundary layer method, the viscous-inviscid interaction method, and the time-averaged Navier-Stokes method. Characteristic trends in skin friction coefficient, displacement thickness, and boundary layer velocity profiles with increasing angle of attack are observed. Computational results are compared to each other and to experimental photographs visualizing the density flowfield using Point Diffraction Interferometry. Both the viscous-inviscid method and the Navier-Stokes method failed to accurately represent leading edge separation bubbles. The direct boundary layer method, usually considered of very limited usefulness due to a singularity in the underlying equations at separation, is shown to exhibit unexpected recovery behavior for small amounts of separation. Furthermore, the results near the leading edge, where separation bubbles were computed, were validated by the experiment.

DESIGN AND CONTROL OF A SPACE BASED TWO LINK MANIPULATOR W/LYAPUNOV BASED CONTROL LAWS

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The Flexible Spacecraft Simulator (FSS) at the Naval Postgraduate School was modified by replacing the flexible appendage with a two link robotic manipulator. This experimental setup was designed to simulate motion of a spacecraft about the pitch axis. The spacecraft consists of a main body, a two link manipulator, and momentum wheel actuator to control the pitch attitude of the spacecraft. Position information from the main body and manipulators was obtained from Rotary Variable Displacement Transducers (RVDT). The equations of motion were developed assuming that the main body and manipulator were rigid bodies. The resulting coupled, nonlinear, time invariant equations of motion were used to analyze the dynamics and kinematics of the main body and manipulator as well as the interaction between the main body and manipulator. Three different control strategies were developed using Lyapunov's Second or Direct Method. With the first controller, simple linear feedback of position and velocity information with constant gains was used to position the manipulator and stabilize the main body. A fifth order polynomial was used to generate a reference trajectory for the second controller. This trajectory was used in conjunction with a tracking controller to position and stabilize the system. In the third controller, a near-minimum-time technique was used to generate a reference trajectory. This reference trajectory was employed using a tracking controller similar to that used in the polynomial reference controller.

DESIGN OF A MICROPROCESSOR-BASED CONTROL SYSTEM FOR THE MONTEREY INSTITUTE FOR RESEARCH IN ASTRONOMY 36" TELESCOPE

David Paul Wood-Lieutenant, United States Navy
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M.S., Naval Postgraduate School, 1991
Aeronautical and Astronautical Engineer-June 1992
Advisors: W.B. Weaver-M.I.R.A. &
I. Michael Ross-Department of Aeronautics and Astronautics

The use of computer technology to control large pointing systems can significantly improve performance and reduce human work load. The goal of this thesis was to design software for an inexpensive, yet accurate and efficient control system for the 36-inch reflecting telescope owned and operated by the Monterey Institute for Research in Astronomy. Within this thesis, a computer program is developed to automatically move the telescope to a set of celestial coordinates and track with an accuracy of one-tenth of an arc second for five minutes within 75° of the zenith. Set times are anticipated to be between four and thirty seconds. Corrections are made to celestial coordinates to account for precession, nutation, aberration and atmospheric refraction effects. The user is provided an interface to the computer-based system that allows storage and editing of 100 star positions, editing of the system parameters and display of the telescope's status. Manual control of the telescope is also permitted at any time. Safety of the telescope structure is the primary concern of system software.

A WING ROCK MODEL FOR THE F-14A AIRCRAFT

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M.S., Naval Postgraduate School, 1990
Aeronautical and Astronautical Engineer-June 1992
Advisor: Louis V. Schmidt-Department of Aeronautical and Astronautical Engineering

An investigation of inertial coupling and its contribution to wing rock in the F-14A aircraft has been conducted. Wind tunnel data was used to obtain the stability parameters for angles of attack from zero to 25 degrees, after which linear and nonlinear analyses of the equations of motion were completed. The linearized analysis of the uncoupled longitudinal and lateral-directional equations was included to provide a baseline for comparison with the fully coupled, nonlinear equations. In both cases, the equations of motion were solved numerically and time history traces produced to illustrate aircraft response. Results indicate that a stable short period mode can feed damping energy into an unstable dutch roll mode via the coupling of the equations to produce a stable limit cycle very similar to those experienced in the aircraft. Numerous suggestions for follow on research are presented.

ELECTRICAL ENGINEER

A MIXED EXCITATION VOCODER WITH FUZZY LOGIC CLASSIFIER

James Thomas Moore-Lieutenant, United States Coast Guard
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Electrical Engineer-June 1992
Advisor: Murali Tummala-Department of Electrical and Computer Engineering

The aim of this thesis work is to explore the use of fuzzy systems in a speech coding and classification application. A mixed excitation LPC based speech coder is developed. The excitation classifier for the speech coder is then implemented using a fuzzy system. The fuzzy logic based classifier determines the type of excitation to be used in constructing the synthetic speech. The results of various implementations of this speech coder are presented for comparison. This work demonstrates that a fuzzy system can be developed and implemented for a classification problem.

MASTER OF SCIENCE
IN
AERONAUTICAL ENGINEERING

APPLICATION OF NEURAL NETWORK TO ADAPTIVE CONTROL THEORY FOR SUPER-AUGMENTED AIRCRAFT

Denis J.S.R. Bertrand-Captain, Canadian Army
B.E.E, Royal Military College of Kingston, 1985
Master of Science in Aeronautical Engineering-December 1991
Aeronautical Engineer-December 1991
Advisor: Daniel J. Collins-Department of Aeronautical and Astronautical

The neural network structures developed in this thesis demonstrate the ability of parallel distributed processing in solving adaptive control problems. Adaptive control theory implies a combination of a control method and a model estimation. The control method investigated is the Lyapunov Model Reference Adaptive Control or MRAC and the model estimation investigated is the linear least square estimator. The neural network theory is introduced with emphasis on the back-propagation algorithm. The implementation of the neural network adaptive control structure is demonstrated on the longitudinal dynamics of the X-29 fighter aircraft. Three configurations are proposed to train the neural network adaptive control structures to provide the appropriate inputs to the unstable X-29 plant so that desired responses could be obtained. These configurations are presented in eight cases, which emulates stable systems like the X-29 closed-loop plant or the optimal and the limited X-29 controllers, and unstable systems like the X-29 plant or its inverse.

EXPLORING PLASMA SHEATH SOLUTIONS FOR PLANAR AND CYLINDRICAL ANODES

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Master of Science in Aeronautical Engineering-December 1991
Advisor: Oscar Biblarz-Department of Aeronautical Engineering

Anode sheaths impact the operation of many practical plasma devices. This complex region is explored in detail for collisional, isothermal (identical specie temperatures), low-temperature plasmas, where sheath dimensions are in the micron range. The selected approach involves postulation of a specific electric field distribution with two shape factors. Previous research regarding planar anodes is verified and expanded upon using greater parameter ranges. 'Z', a dimensionless quantity specifying plasma composition and condition, groups diverse plasmas into 'families' exhibiting similar sheath characteristics. ' η ', a nondimensional ratio of electrical energy to thermal energy in the sheath, allows temperature effects to be studied. The investigation focuses on three disparate plasma families that span a z range of 1.1729 to 2. 1493, at η values defined by plasma temperatures of 6000°K, 3000°K, and 300°K. Results indicate that at lower temperatures, charge production in the outer sheath is generic to the electric field distribution, and that the sheaths themselves are nearly unaffected by substantial changes in temperature (i.e., η). Conversely, sheath density and extent are shown to vary significantly for differing z values. Newly-derived equations governing cylindrical anodes generate sheaths that are virtually identical to corresponding planar cases. It is shown that only those anodes whose radii are comparable to the plasma's 'characteristic radius' (γ) must be treated with the cylindrical formulation; non-vacuous plasmas would require micron-width anodes to be thus affected. Finally, an analytical approach yields solutions that confirm the numerical results, and offers an algebraic approximation for high- η plasmas.

EXPLORATORY EXPERIMENTAL INVESTIGATION OF A WAVE PROPELLER

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Master of Science in Aeronautical Engineering-March 1992
Advisor: Max F. Platzer-Department of Aeronautics and Astronautics

A low-speed wind tunnel investigation was conducted to determine if a small secondary airfoil, or wave propeller, oscillating in a rotary plunging motion, could significantly affect the airflow over a lifting airfoil surface enough to delay the onset of stall. The lifting airfoil shape was a NACA 66(215)-216, chosen for it's chordwise pressure port instrumentation. Testing consisted of measuring the pressure distribution of the NACA 66(215)-216 airfoil past the stall angle-of-attack, and then again in combination with the wave propeller. The wave propeller was located in two different positions; above the lifting airfoil's trailing edge, and aft of the trailing edge. The propeller was operated in both clockwise and counter-clockwise directions. The propeller effectiveness was evaluated by comparing the pressure distributions and computed lift curve slopes with and without propeller operation. Reynolds number varied from 1.4×10^5 to 2.57×10^5. Mechanical limitations resulted in testing to only ten percent of the desired wave propeller speeds. Results indicated that the wave propeller acted to block the air flow over the lifting wing causing early separation and loss of lift.

STATISTICAL FATIGUE ANALYSIS OF THE SH-60B SERVO BEAM RAIL COMPONENT

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Statistical methods were researched to better understand the effect of flight loads on the servo beam rail component of the SH-60B helicopter. The extreme value distribution and the Weibull distribution were used to model the distribution of flight loads. Specifically, the flight loads for the symmetric pullout maneuver were studied. Both models successfully represented the data, although more data are required to be fully confident in these representations. Different flight characteristics indicate that various factors such as gross weight, airspeed, and collective position effect the distribution of loads. The model runs indicate a good representation of the individual runs in fatigue life calculations. The damage calculated for the Sikorsky substantiation load run was less conservative than the model run. In addition, the maximum load of the substantiation run was only in the 45th percentile of the load distribution estimated using an extreme value distribution for loads. The damage calculated for the Sikorsky substantiation load run was more conservative than the damage calculated for the individual runs which was reduced as much as 100 times when corrected for mean load.

FLEXURAL WAVE PROPAGATION IN ANISOTROPIC LAMINATES AND INVERSION ALGORITHMS TO RECOVER ELASTIC CONSTANTS USING PHASE VELOCITY MEASUREMENTS

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Knowledge of the elastic properties of composite materials can be an invaluable tool for both the quality assurance of manufacturing techniques and design verification. Recent advancements in ultrasonic velocity measurements have demonstrated the ability to recover elastic properties in anisotropic laminates. A simplified experimental setup was investigated to recover the elastic properties based upon the flexural wave propagation in anisotropic laminates. The initial objective of this thesis was to verify flexural wave propagation in composite laminates through the comparison of experimental and theoretical phase velocities. In the second part of this thesis, the experimental phase velocities were used to calculate the elastic properties of the material by inverting the governing equations. The initial method used to recover elastic constants was successful in the recovery of a partial set of the bending and extensional stiffnesses. The inability to recover all bending stiffnesses dictated the investigation of a second method. This method used an iterative method based upon a nonlinear Newton's method to recover the bending stiffnesses. This method did not converge due to ill conditioning of the solution matrix. Although this method did not converge, it is believed that other more robust methods suggested herein would converge to the proper solution.

REAL-TIME DETECTION OF FATIGUE CRACKS AT MULTIPLE HOLES IN 7075 ALUMINUM USING ACOUSTIC EMISSION

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Master of Science Aeronautical Engineering-September 1992
Advisor: Michael Gorman-Department of Aeronautics and Astronautics

In the E-2C Hawkeye's wing center section, stress fractures have been identified in the main beam web section. The cracks occurred in several web section attachment holes. Previous work, concerned with fatigue data, used a finite element code to design a specimen which modeled the actual section of the beam at one particular fastener hole near wing station 49. Acoustic emission testing was used to determine if crack initiation could be identified. In this work, acoustic emission techniques were applied to the monitoring of multiple cracks. The E-2C fatigue spectrum was used to load the specimens but fatigue testing was not an objective. Specimens were modified by drilling holes and attaching angles that represented the structural shapes used to attach the section to the wing skin. The original one-hole configuration and the new multiple hole specimen configuration were tested. The cap angles were found to create a great deal of noise containing frequency components below 400kHz. Special high pass filters were fabricated which eliminated most of this noise. It was shown that linear location could be used to discriminate between crack growth signals and the filtered noise signals.

DEVELOPMENT OF TELEMETRY FOR THE AGILITY FLIGHT TEST OF A RADIO CONTROLLED FIGHTER MODEL

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Master of Science in Aeronautical Engineering-March 1992
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Advanced design tools, control devices, and supermaneuverability concepts provide innovative solutions to traditional aircraft design trade-offs. Emerging technologies enable improved agility throughout the performance envelope. Unmanned Air Vehicles provide an excellent platform for dynamic measurements and agility research. A 1/8-scaled F-16A ducted-fan radio-controlled aircraft was instrumented with a telemetry system to acquire angle of attach, sideslip angle, control surface deflection, throttle position, and airspeed data. A portable ground station was built to record and visually present real-time telemetry data. Flight tests will be conducted to acquire baseline high angle-of-attack performance measurements, and follow-on research will evaluate agility improvements with varied control configurations.

A METHOD OF TESTING TWO-DIMENSIONAL AIRFOILS

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The Naval Postgraduate School Aeronautics and Astronautics Department conducts research and development for the Navy's Unmanned Air Vehicle program. NPS currently lacks the capability of testing two-dimensional airfoils to obtain lift, drag and pitching moment coefficients. This thesis consists of the design and calibration of a method of measuring these coefficients using strain gages, and the method of obtaining purely two-dimensional flow over the airfoil. During the calibration process, two amplifiers were tested in an attempt to minimize system drift and to ensure repeatability during successive runs. These desired characteristics were not achieved, however. The final phase was to be validation of the design by testing an NACA 0012 airfoil and comparing measured airfoil data with established reference data. This final phase was not completed due to structural failure of the airfoil.

FLIGHT TESTING OF A HALF-SCALED REMOTELY PILOTED VEHICLE

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Flight testing of a half-scale Pioneer remotely piloted vehicle was conducted to determine the longitudinal static stability flying qualities. A pulsewidth modulated telemetry system was used to provide data on control surface deflections, angle of attack, sideslip angle and airspeed. From the testing, the neutral point was determined to be 41.2% of mean aerodynamic chord, which was within 13% of theoretical predictions. On a subsequent flight, the Pioneer experienced electromagnetic interference which caused the disruption of the flight control uplink signal, causing it to fly uncontrolled into the ground. Simultaneous playback of video and time histories of downlink data was instructional in analyzing the interference leading to the accident.

PRELIMINARY DEVELOPMENT OF A VTOL UNMANNED AIR VEHICLE FOR THE CLOSE-RANGE MISSION

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The preliminary development of a full-scale Vertical Takeoff and Landing (VTOL) Unmanned Air Vehicle (UAV) for the Close-Range mission was completed at the Naval Postgraduate School (NPS). The vehicle was based on half-scale ducted-fan investigations performed at the UAV Flight Research Lab. The resulting design is a fixed-duct, tail-sitter UAV with a canard-configured horizontal stabilizer. Major airframe components are used from previous UAVs and include the wings from a U.S. Army Aquila and the ducted fan from the U.S. Marine Corps AROD. Accomplishments include: 1) the design and fabrication of a carry-through spar and 2) the design and construction of an engine test stand. The carry-through spar was designed using finite element analysis and constructed from composite materials. The purpose of the test stand is to measure torque, horsepower, and thrust of an entire ducted fan or an individual engine. Completion of this thesis will pave the way for future NPS research into the growing interest in VTOL UAV technology.

STATIC AND DYNAMIC FLOW VISUALIZATION STUDIES OF TWO DOUBLE-DELTA WING MODELS AT HIGH ANGLES OF ATTACK

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A water tunnel flow visualization was performed to study the vortex development and bursting phenomena on a baseline double delta wing model and a modified double delta wing model. The primary focus of this study was two-fold: First, to study the static and dynamic effects of pitch and pitch rate on the vortical flowfield of the individual models. Second, to compare the vortex breakdown characteristics of these two models under static and dynamic conditions. Results indicate that the vortex burst location moves forward with increasing AOA for both the models relative to the static case, the bursting is delayed during pitch-up motion with the vortex burst lag increasing with the pitch rate. Compared with the baseline model, the small geometry modification at the strake/wing junction of the modified model changes the local flowfield by developing the wing vortex earlier and promoting earlier coiling-up of strake and wing vortices.

EFFECT OF CANARD OSCILLATIONS ON THE VORTICAL FLOWFIELD OF A X-31A-LIKE FIGHTER AIRCRAFT MODEL

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A flow visualization investigation was carried out in the Naval Postgraduate School water tunnel using dye injection technique to study the effects of oscillating a close-coupled canard on a 2.3% scale model of a X-31A-like fighter aircraft. This investigation focussed primarily on the effects of canard oscillations on the breakdown characteristics of the wing root vortex for both static and dynamic conditions of the model at zero sideslip angle. The main results of this first of a kind water tunnel visualization data suggest that for the static conditions of the model the low frequency/high frequency canard oscillation tend to destabilized/augment wing vortex core, i.e., promote/delay bursting of the wing vortex. The dynamic tests indicate that the large amplitude low frequency oscillations of the canard interact favorably with the wing vortical flowfield to delay vortex bursting during both pitch-up and pitch-down motions.

ANALYSIS OF IN-FLIGHT STRUCTURAL FAILURES OF P-3C WING LEADING EDGE SEGMENTS

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A quantitative analysis was carried out to determine the stresses present in the leading-edge segment of a P-3C aircraft operating within and outside the normal operating envelope of the aircraft. The purpose of the analysis was to ascertain whether a specific weakness may exist in the leading-edge structure which might endanger future operating flight crews. A three-step process consisting of a static aeroelastic span-load analysis, an inviscid two-dimensional panel method, and finite-element analysis was employed in the course of the evaluation. Lift-coefficient distributions from the wing span-load analyses were used in the two-dimensional panel method to determine the pressure distribution around the leading edge, which was then used as input to the finite element analysis. Additionally, static aeroelastic-derived wing-twist effects were included in the structural model. The results of the analysis suggest that the leading edge segment studied may experience stress levels sufficient to cause failure within the normal operating envelope.

SOLID FUEL RAMJET INFRARED SIGNATURE

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The objective of the thesis was to determine the effects of equivalence ratio (ϕ) and fuel composition on the infrared signature of solid fueled ramjets (SFRJ). Solid fuels investigated were Plexiglas, HTPB, and HTPB with aluminum, silicon, boron carbide, and/or magnesium. They were tested at chamber pressures of 80-170 psia and with equivalence ratios between 0.3 and 1.4. With the plume emissivity set to 1.0, plume irradiance was found to increase approximately with the second power of the actual combustor stagnation temperature. In addition to providing needed plume signature data for the SFRJ, this information can be used to validate numerical predictions from the SPF (Standardized Plume Flowfield) and SIRRM (Standardized Infrared Radiation Model) computer codes, which are used to predict the plume infrared signature.

FLOWFIELD STUDY OF A CLOSE-COUPLED CANARD CONFIGURATION

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A nulling five-hole pressure probe was used to complete a flowfield survey behind a close-coupled canard and wing model set at 22 degrees angle of attack. The canard and wing were both low-aspect-ratio, highly-swept, delta planforms with rounded leading edges. The model was set at the condition of maximum lift enhancement of the canard/wing configuration over a corresponding wing-alone configuration, based on previous force measurements. For comparison, the pressure measurements were made with the canard on and with the canard off. From the pressure measurements, flowfield velocity-vector, velocity-streamline and total-pressure-coefficient contours were plotted. These plots showed the dramatic effect of the canard vortex on the wing flowfield. The location and interaction of the canard and wing leading-edge vortices were analyzed. Large-scale reattachment of previously reversed flow over the wing was noted, as well as the re-establishment and strengthening of the wing leading-edge vortex.

NUMERICAL ANALYSIS OF THE FLOW IN A TURBULATED RECTANGULAR DUCT SIMULATING THE COOLING PASSAGES IN A TURBINE BLADE

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An extensive review of the literature revealed that many experimental studies have been conducted in heat-transfer wind tunnels simulating the cooling passages in turbine blades. However, very few numerical studies have been performed. Phoenics, a computational fluid dynamics computer program, produced results for several duct configurations and calculated the heat transfer characteristics of each. The configurations investigated included a straight, square duct and a rectangular duct with turbulators (a form of turbulence promoters) present. The parameters varied included Reynolds numbers, turbulence intensity and grid geometry. Results for the turbulated duct indicated highly distinct and repeatable flow patterns developed over a wide range of values. The variation of the inlet turbulence intensity had little impact on the kinetic energy. The results proved to be highly grid dependent, which greatly impacted the correlation between experimentally and numerically produced data, for the same configurations, under similar operating parameters.

BASELINE VIBRATION MEASUREMENTS OF REMOTELY PILOTED HELICOPTERS FOR HIGHER HARMONIC CONTROL RESEARCH

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The Department of Aeronautics and Astronautics at the Naval Postgraduate School (NPS) is conducting a research program in methods of higher harmonic control (HHC) for reduction of helicopter vibrations. The program at NPS uses remotely piloted helicopters (RPH) to study HHC effects on vibration and blade load reduction. The scope of this master's thesis was to measure the baseline vibration profile of the RPH test vehicles prior to the installation of a HHC system. This goal was met by the development of a data instrumentation and recording system and by conducting a ground and flight test program for the RPH test vehicles. From the results of these tests it was concluded that: a) the data instrumentation and recording system was of sufficient sensitivity to detect vibrations experienced within the RPH airframe; and b) the RPH exhibited a vibration profile similar to that of a full scale helicopter. It is recommended that a HHC system be designed, fabricated, and installed on the RPH so that the effects of HHC on helicopter performance may be evaluated.

TWO-DIMENSIONAL BOUNDARY SURFACES FOR PLANAR EXTERNAL TRANSONIC FLOWS

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The small perturbation, two-dimensional transonic equation is manipulated with a separation-of-variables approach to obtain two ordinary, nonlinear, differential equations. Numerical integration of these implicit differential equations results in new transonic boundary surfaces for planar external flows. A key ingredient in these solutions is the identification of dependence of two integrations constants, α and ß, on the parameter $(1-M_\infty^2)$. The physical reality of our boundary surfaces is examined by displaying the boundary conditions they satisfy. The strictly sonic flow $M_\infty = 1.0$) has an analytic representation corresponding to a divergent surface which goes supersonic. This sonic solution is compared with an Euler-CFD approach confirming the validity of our results over the region where small perturbations apply. Solutions are also shown for $M_\infty = 0.8$, 0.9, 1.1, and 1.2. These results are consistent with known behavior for both subsonic and supersonic external flow. Since the results of this work yield actual transonic contours, we can examine shockless surfaces for design applications. Finally an entire transonic upper surface is presented for $M_\infty = 0.8$, by patching a subsonic Mach number, which reaches a plateau at M-1.0, with a sonic flow. This patching requires the careful interpretation of a nondimensional reference length, called Y_0, which is a function of M_∞.

LIFT ENHANCEMENT USING A CLOSE-COUPLED OSCILLATING CANARD

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A wind-tunnel study to investigate the effects of dynamic stall of a close-coupled canard on the canard/wing vortex interaction for increased lift enhancement was conducted. Two angles of attack of the model were studied: one at the first stall condition of the wing and one in the post-stall regime where a strong leading-edge vortex was formed. Baseline force and moment parameters were measured at mean canard deflections based on those determined to be optimum for the static case, as were mean values ± 3 degrees about the optimum. The amplitude of oscillation considered was ± 5 degrees about each mean; reduced frequencies tested were from 0.046 to 0.232. For most cases, lift was enhanced beyond the static-canard case at mean deflections equal to those at or greater than the static optimum value. The effective lift was decreased for mean deflections less than those previously determined to be optimum. Lift enhancements were generally 2 to 6 percent higher than the values determined with the static canard. The increased lift was generally independent of reduced frequency and peaked between k values of 0.1 to 0.2.

AN INVESTIGATION OF A PROTOTYPE OASYS' EFFECTIVENESS IN MANEUVERING FLIGHT

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An analysis of the current Northrop helicopter obstacle avoidance system (OASYS) prototype with a fixed forward mounting, 25 x 50 degree field of view, 860 nanometer wavelength LADAR, was conducted to determine system effectiveness during simulated aircraft level accelerations ranging from 0 to 100 knots, and at acceleration rates of from 0 to 2.9 meters/sec^2. Computer simulation flights were conducted using flight parameter data recorded at the Army Aeroflightdynamics Directorate Crew Station Research and Development Facility's (CSRDF) advanced concepts flight simulator. A multiple-program computer simulation was used to model the helicopter and sensor dynamics over a tactical data base of numerous obstacles consisting of trees, wires, and poles; the resulting window of safety (WOS) displays were analyzed by comparing each acceleration maneuver with a control maneuver in which the sensor was horizon stabilized. A mathematical model of the flight maneuvers for which the OASYS prototype operated effectively was then determined based on the results of these simulations. The limits of this analytical flight envelope were than verified experimentally via a series of computer simulations using generalized maneuvers conducted over a standardized obstacle data base.

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE VIBRATION CHARACTERISTICS OF A REMOTELY PILOTED HELICOPTER

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The Department of Aeronautics and Astronautics at the Naval Postgraduate School is involved in an ongoing program of Higher Harmonic Control (HHC) research using Remotely Piloted Helicopters (RPH). To date a host RPH has been acquired and a preliminary HHC system design study completed. This thesis reports the results of free vibration shake test conducted on the host RPH as well as efforts to construct a representative finite element model of the vehicle. Broadband noise was used to excite the structure both laterally and vertically from 10-200 Hz in an attempt to accurately document the airframe and rotor system dynamics. Primary airframe structural modes were identified in the tail boom and at frequencies well below the characteristic 4/rev (78.3 Hz) main rotor induced vibration frequency. These modes should not be of concern at normal operating rpm. Main rotor blade modes were documented under non-rotating conditions then extended to predict the modes at operating rpm. Finally, a finite element model of the structure was constructed. Difficulties in matching finite element predictions with experimental results, however, will require further refinements to the computer model before it can become a useful design tool.

RPH PRELIMINARY DESIGN, TREND ANALYSIS AND INITIAL ANALYSIS OF THE NPS HUMMINGBIRD

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The Department of Aeronautics and Astronautics at the Naval Postgraduate School (NPS) is expanding its helicopter research capabilities in order to facilitate present and future research demands. The rapidly changing needs have already out paced available assets. Therefore it was necessary to design and develop a new remotely piloted helicopter (RPH) that would meet present needs, NOTAR and HHC, and be flexible enough to meet future needs. The research efforts encompassed by this thesis are defining the present needs, investigating what type/size of RPH would fulfill these needs, procuring this asset, and analyzing its capabilities. Based on a defined payload, helicopter trends are analyzed to determine an estimate of the overall RPH size (gross weight) and engine size required. A preliminary design process validates these figures. Choosing to procure an RPH instead of building one, a detailed performance analysis is conducted on the main rotor system. This analysis includes blade vibration analysis, retreating blade stall analysis, and power required analysis. Modification of the RPH's main rotor hub, drive train, and landing gear are studied and recommendations presented. This research effort is a continuation of a long-term program to provide NPS with robust assets to support present and future rotorcraft research efforts.

STUDY OF STATISTICAL VARIATIONS OF LOAD SPECTRA AND MATERIAL PROPERTIES ON AIRCRAFT FATIGUE LIFE

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NAVAIR utilizes the fatigue spectrum of an existing Navy aircraft to set the structural design requirements for a new Navy aircraft. The current design requirement is for the new aircraft to withstand a fatigue spectrum at least as severe as the spectrum experienced by 99.73% (3 standard deviations) of the aircraft from which the design requirement originated. Two years of A-6 data were used in the study, which contained the number of g exceedences at the four g, five g, six g, and seven g levels. Trade off studies were completed to analytically examine the variation in the fatigue life of an aircraft while varying the reference stress at the notch of a crack, re-ordering of the load sequences within the spectrum, varying the 3 sigma design requirement, and changing the material properties of the metal. The results indicated that NAVAIR's current requirement for a new aircraft to withstand a three σ spectrum may be too severe. This conclusion is only valid for a three σ spectrum based on the A-6 load history.

PREDICTION OF TURBINE CASCADE FLOWS WITH A QUASI-THREE-DIMENSIONAL ROTOR VISCOUS CODE AND THE EXTENSION OF THE ALGEBRAIC TURBULENCE MODEL

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A quasi-three-dimensional rotor viscous code is used to predict high subsonic flow through an annular cascade of turbine blades. The well known Baldwin-Lomax turbulence model is used in the program. An attempt was made to implement a new turbulence model, based on renormalization group theory in the program. This was done to improve the prediction of the boundary layer transition on the blade surfaces and subsequent wake development. The comparison of these two turbulence models with experimental data are presented. Pressure, velocity ratio, flow angle distributions and downstream wake predictions were studied using results from Rotor Viscous Code Quasi-Three-Dimensional. The computed results showed good agreement with experiment when comparing the blade surface local static pressure to inlet total pressure ratio at the midspan position of the annular turbine cascade. The computational approach used to implement the turbulence model is also described.

UPGRADE AND EXTENSION OF THE DATA ACQUISITION SYSTEM FOR PROPULSION AND GAS DYNAMICS LABORATORIES

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Advisor: Raymond P. Shreeve-Department of Aeronautics and Astronautics

The goal of the present work was to upgrade the data acquisition system (DAS) in the high-speed building of the Turbopropulsion Laboratory (TPL) and to develop a high-speed acquisition capability for pressure measurements for both the TPL and the new Gas Dynamics Laboratory (GDL). Based on the use of the Hewlett Packard HP9000 Series 300 Computer as the system controller, a 96-channel high-speed pressure DAS was developed using Scanivalve ZOC-14 modules and a CALSYS2000 calibrator. The system allowed acquisition times for current wind-tunnel experiments to be revised from four minutes to eleven seconds. Also, new software was written to acquire data from existing rotary pneumatic Scanivalves and HP-IB compatible instrumentation so that all other existing acquisition capabilities were maintained in both laboratories.

QUANTITATIVE FORCE MEASUREMENTS OF PNEUMATIC CONTROL ON A WING/STRAKE MODEL

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A low-speed wind-tunnel study to quantitatively measure the lift and drag effects of pneumatically controlling a leading edge vortex generated by a half-span, generic-fighter-wing model was conducted. The study measured the added lift and drag upon the model, throughout a range of angles of attack, utilizing blowing tubes of different geometry and orientations. The effects of blowing upon the high pressure side of the strake were also investigated. Results showed that the effects of blowing were limited to changes in lift with no apparent changes in drag. Blowing appeared to reattach the flow during the initial stages of wing stall. Blowing increased lift by a maximum of 3.75% at angles of attack greater than 25°. The effects of blowing appeared oscillatory with respect to angle of attack. Blowing rates were varied from $C_\mu = 0.0$ to 0.0035 in an attempt to determine an optimum. It was found that changes in blowing rates had little effect upon ΔC_L.

IR IMAGING FOR COMBUSTION CHARACTERISTICS AND OPTICAL PROPERTIES OF BORON/BORON OXIDE

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An experimental investigation was conducted to determine if a new high speed IR microscope could be used to study the ignition and combustion characteristics of boron/boron carbide and to measure the particle emissivity as a function of temperature. Air heater limitations did not permit the investigation of ignition characteristics. Emissivity in the 2 - 5 μm band was measured as a function of temperature using a small boron filament. Data obtained using different IR band-pass filters resulted in significantly different results due to the apparent dependence of the emissivity of boron oxide on both temperature and wavelength. It was also found that care must be used to ensure that the entire image is in sharp focus and that a means must be provided for measuring an accurate surface temperature.

MASTER OF SCIENCE
IN
ASTRONAUTICAL ENGINEERING

AN INVESTIGATION INTO THE PERFORMANCE CHARACTERISTICS OF A SOLID FUEL SCRAMJET PROPULSION DEVICE

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An investigation was conducted to evaluate the performance qualities of a supersonic ramjet propulsion device (SCRAMJET) using a solid fuel. The fuel grains were fabricated from Plexiglas and were cylindrical, with an axisymmetric, circular perforation that diverged in the downstream direction. A small amount of hydrogen gas was required in an initial recirculation zone in order to sustain combustion. With combustor inlet conditions of 150 psia, 1000°R, and a Mach number of 1.5, a combustor exit Mach number of approximately 1.4 was maintained. Due to poor mixing conditions, the combustion efficiency of the solid fuel was only 57%.

CLUSTER MODEL OF POLARIZATION UPON REFLECTION FROM METALLIC SURFACES

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Polarization of light due to metallic reflection is at best only partially explained by current models. A new model is proposed to account for this phenomenon involving "native clusters". These clusters are assumed to be an integral part of metallic bulk surfaces and to manifest their dielectric properties in the visible region. An index of refraction may be computed based on a pseudo-Brewster angle, that angle of incidence where the minimum perpendicular reflectance occurs. Next the model identifies the cluster-to-bulk surface area ratio of the material and formulates the contribution of reflection from these areas by utilizing the Fresnel equations. Reflectance from the remainder, the bulk-surface area, is computed by applying conventional metallic reflection techniques. By combining the two contributions of reflectance for angles of incidence from 0 to 90 degrees, reflectance curves are generated for gold, silver, nickel and aluminum. These calculations assume a wide-band radiating source of light. Although the magnitude of reflectance for the model showed some variance over the range of angles of incidence (within 10%), the curves are similar in shape. The minimum perpendicular reflectance and grazing angles of incidence are consistent with experimental findings. The computed surface ratio for each metal varies indirectly with the metals' normal reflectance value, as expected from the model. Spectral information on the complex index of refraction is included to infer probable cluster size.

PROPOSED MODEL OF THERMIONICALLY ASSISTED BREAKDOWN AND IMPLEMENTATION ON ELECTROSTATIC THRUSTERS

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A model for thermionically assisted breakdown is proposed which predicts the voltage reduction experienced in low voltage discharges. This reduction in breakdown voltage has been beneficial to numerous engineering applications of arcs and is explored herein specifically for electrostatic thrusters. Full advantage in employing thermionically assisted breakdown is attained by establishing a continuum of electron emission across the primary discharge gap. These electrons must be independent of the discharge itself, being established prior to ignition. The electron emission is therefore achieved by auxiliary emitters across the gap. Electrons amass in a space charge in the vicinity of the assisting device. The particular processes which induce charge multiplication are proposed to be multistep ionization and neutralization of the space charge by ions. Breakdown criteria and a means of estimating the reduction in breakdown voltage requirement are derived. One proposal for the thermionically assisting emission device is the coiled-coil filament, and a scheme for installing such filaments in ionization chambers for electrostatic thrusters is described. Thermionically assisted breakdown implementation should also pertain to arc applications for various primary electrode geometries as well as certain gases.

PROBABILISTIC STRENGTH-LIFE MODEL FOR GRAPHITE FIBERS UNDER STRESS

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The work done in this investigation is part of a continuing program designed to develop probabilistic strength and life models for filament composite materials. In this particular experiment, groups of single fibers from two chemically identical different production spools of graphite were loaded to identical sustained tensile loads in order to determine their life statistics while under stress. While previous work has produced models of composite reliability as a function of strength, this work develops a model which will be necessary to predict the reliability of composite fibers as a function of time. Parametric and non-parametric methods were used to quantify the relationship between fiber reliability as a function of stress and as a function of time.

STATIC PRESSURE MEASUREMENTS OF THE SHOCK-BOUNDARY LAYER INTERACTION IN A SIMULATED FAN PASSAGE

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Two-dimensional experimental and numerical simulations of a transonic fan blade passage (M = 1.4) were conducted to provide baseline data for the study of the effects of vortex generating devices on shock-boundary layer interaction. A back pressure valve was designed for a transonic cascade blowdown wind tunnel, the test section was instrumented, and time-averaged static pressure distributions across the shock-boundary layer interaction were obtained. A numerical Navier-Stokes solution to the flow was also found. Sensitive and repeatable control of the cascade pressure ratio was demonstrated and the flow was shown to be reasonably two-dimensional across the span.

DEVELOPMENT OF AN ACTIVE DAMPING SYSTEM TO AID IN THE ATTITUDE CONTROL OF FLEXIBLE SPACECRAFT

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This thesis details the further refinement of the Naval Postgraduate School's Flexible Spacecraft Simulator and the first successful experimental control of the flexible system. The major emphasis of this work has been the development of a system to provide active damping to aid in control of the flexible modes of the system. The completed design of the circuit and the choice and placement of the piezoceramic sensors and actuators are presented. Full operation of the completed damping system has not yet been achieved. Verification of the computer model of the flexible system without active damping was completed and comparisons between the analytical and the experimental results are presented for simple proportional-derivative (PD) control using the main body angular position and rate.

COMPUTER-BASED SATELLITE DESIGN

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Master of Science in Astronautical Engineering-June 1992
Advisor: Brij N. Agrawal-Department of Aeronautics and Astronautics

A computer program to design geosynchronous spacecraft has been developed. The program consists of four separate but interrelated executable computer programs. The programs are compiled to run on a DOS-based personal computer. The source computer code is written in DoD mandata Ada programming language. The thesis presents the design technique and design equations used in the program. Detailed analysis is performed in the following areas for both dual-spin and three axis stabilized spacecraft configurations: 1) Mass Propellent Budget and Mass Summary, 2) Battery Cell and Solar Cell Requirements for a Payload Power Requirement, 3) Passive Thermal Control Requirements. Thesis includes a users manual Appendix A, and the source code for the computer programs as Appendix B.

USE OF AN OPTICAL MULTICHANNEL ANALYZER FOR REFLECTIVITY MEASUREMENTS

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Master of Science in Astronautical Engineering-March 1992
Advisor: Oscar Biblarz-Department of Aeronautics and Astronautics

Current theories that attempt to explain the emission and reflection properties of metallic surfaces still provide some room for conjecture and alternative concepts. This is true particularly for processes in the visible portion of the electromagnetic spectrum. One relatively new theory that has recently received increased attention and support is that of the "native cluster" model. The model proposes that metallic surfaces are populated with small groups of atoms that have been liberated from the crystalline lattice structure of the bulk metal. These colloids possess dielectric qualities that act to modify basic properties of the parent material, such as polarizability, electrical conductivity, thermal emission, and luminescence. While proof of luminescence from metallic surfaces would not significantly detract from existing free electron and quantum theory, it would tend to support the "native cluster" model. Due to its reflectivity characteristics, copper was selected as the metal to be studied in this research. One instrument that is well suited for the collection of reflectivity and emission data is the Optical Multichannel Analyzer. Although a powerful tool for spectral research, the requirement of a significant initial investment of time necessary to gain sufficient user familiarity to become proficient with the equipment has resulted in the instrument being underutilized. Therefore, in addition to the primary aim of this research in evaluating the ability of a polished copper surface to luminesce, a secondary aim was to evaluate the characteristics and applicability of this instrument to support the luminescence research. The results of this research were the development of user friendly checklists for basic operation of the OMA III, a determination of error sources due to experimental equipment and procedures, the magnitudes of those errors, substantiation of the results by reproducing known metallic reflectivity data, and the collection of data indicating the possible existence of luminescence from a copper surface.

ORBITAL MAINTENANCE OF ENDOATMOSPHERIC LOW EARTH-ORBITING SATELLITES

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Master of Science in Astronautical Engineering-December 1991
Advisor: I. Michael Ross-Department of Aeronautics and Astronautics

The optimization of spacecraft trajectories in vacuum has received extensive consideration since the inception of space flight, yet, the effects of atmosphere have been largely neglected. The advent of low Earth-orbiting, large satellites and platforms necessitates that atmosphere be included in the optimization process. A practical means of studying this topic is as a problem in minimum-fuel orbital maintenance. Optimal control theory advances the notion that orbital maintenance is optimized through periodic thrusting as opposed to forcing Keplarian motion by nullifying the effects of drag with thrust. Further, this must be optimized by primer vectoring. This thesis examined the efficiency of a simple method of orbital maintenance using fixed-angle transverse thrusting. Results show that for the purpose of fuel-minimization, the width of the radial band in which the satellite is to be maintained, is dependent upon thruster size. In nearly all cases, a thrust-angle of 70 degrees maximized the fuel saved. This thesis shows that fixed-angle transverse thrusting does not improve on forced Keplarian motion and hence thrust vectoring must be optimized.

SUBSCALE SOLID ROCKET MOTOR INFRARED SIGNATURE AND PARTICLE BEHAVIOR

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Master of Science in Astronautical Engineering-December 1991
Advisor: David W. Netzer-Department of Aeronautics and Astronautics

A combined optical and particle collection probe which employed an in situ particle size distribution measurement method and an infrared camera were used to obtain data that could be used to validate solid propellent rocket motor plume signature prediction codes. The probe design was optimized and the required rates for window purge and ejector flows were determined which provided proper functioning of the probe when placed in the supersonic region of the plume. At the nozzle exit the particle size distribution was quandramodal with most of the particles smaller than 0.5 μ and the largest particles with diameters less than 25 μ. The larger particles present at the nozzle exhaust were not present farther aft in the plume. This behavior was believed to result from breakup of the large molten Al_2O_3 particles in the plume mach discs. However, further work is required to determine if the probe alters the particle size distribution.

DEVELOPMENT OF AN AUTOMATED SCANNING MONOCHROMATOR FOR SENSITIVITY CALIBRATION OF THE MUSTANG INSTRUMENT

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B.S., United States Naval Academy, 1986
Master of Science in Astronautical Engineering-June 1992
Advisor: David D. Cleary-Department of Physics

An Automated Scanning Monochromator was developed using: an Acton Research Corporation (ARC) Monochromator, Ealing photomultiplier tube and a Macintosh PC, in conjunction with LabVIEW software. The LabVIEW Virtual Instrument written to operate the ARC monochromator is a mouse-driven user-friendly program developed specifically for automated spectral data measurements. Resolution and sensitivity of the Automated Scanning Monochromator system have been determined experimentally. The Automated Monochromator was then used for spectral measurements of a platinum lamp. Additionally, the reflectivity curve for a $BaSO_4$ coated screen has been measured. Reflectivity measurements indicate a large discrepancy with expected results. Further analysis of the reflectivity experiment is required for conclusive results.

STRUCTURAL DESIGN, ANALYSIS, AND MODAL TESTING OF THE PETITE AMATEUR NAVY SATELLITE (PANSAT)

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Master of Science in Astronautical Engineering-September 1992
Advisor: Ramesh Kolar-Department of Aeronautics and Astronautics

The Naval Postgraduate School's (NPS) Space Systems Academic Group is developing the Petite Amateur Navy Satellite (PANSAT), a small satellite for digital store-and-forward communication in the amateur frequency band. PANSAT is intended to be a payload of opportunity amenable to a number of launch vehicles. The Shuttle Small Self-Contained Payload (SSCP) program was chosen as a design baseline because of its high margins of safety as a manned system. The PANSAT structure design is presented for the launch requirements of a Shuttle SSCP. A finite element model was developed and studied for the design loads of a SSCP. The results showed the structure to be very robust and likely to accommodate the requirements of other launch vehicles. The finite element analysis was verified by modal testing, correlating the fundamental mode of the finite element model with that of an engineering test structure.

PERFORMANCE ANALYSIS OF NON-COPLANAR SYNERGETIC MANEUVERS

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Master of Science in Astronautical Engineering-December 1991
Advisor: I. Michael Ross-Department of Aeronautics and Astronautics

Maneuvers employing atmospheric forces to assist in orbital changes hold potential for significant fuel savings over purely exoatmospheric propulsive methods. The term synergetic has been coined to describe the combination of propulsive and atmospheric forces used by a maneuvering flight vehicle. This thesis concentrates on non-coplanar synergetic maneuvers using two different control methods for various lifting bodies over a range of heating rates and orbital speeds. The objective of this thesis is to study the aerocruise and aerobang maneuvers. The aerocruise maneuver has been studied for more than twenty years and is commonly thought to be the fuel-optimal solution to a maneuver flown at a constant heating rate. A new maneuver, the aerobang, has recently laid doubt as to the optimality of the aerocruise maneuver. The aerobang maneuver demonstrates the ability to yield a higher inclination change for a given amount of fuel as compared to the aerocruise maneuver. Within this thesis a computer code is developed to model both the aeroband and aerocruise maneuvers. It is shown that there exists flight regimes where the aerobang method is superior to the aerocruise method.

SENSITIVITY OF SENSORS FOR CHARACTERIZING CHAOS

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Master of Science in Astronautical Engineering-December 1991
Advisor: Ramesh Kolar-Department of Aeronautics and Astronautics

Chaos describes a class of motions of a deterministic system whose time history is sensitive to initial conditions. Because of the sensitivity of initial conditions, the response of a dynamical system may result in instabilities. Hence, a study of nonlinear response of structures under the expected frequencies of excitation becomes important. Chaotic behavior, for example, may be found in the vibration response of large flexible space structures including trusses, booms, and radio antennas. Methods of quantifying chaos have been applied to flexible beams both analytically and experimentally. This research effort investigates the effects of sensors, strain gages and accelerometers, in studying chaotic motions. A long flexible beam is used to model the chaotic behavior, which is also mathematically modeled as Duffing's Equation. Time histories are recorded and analyzed using pseudo-phase space, Fourier spectrums, Poincare sections, Lyapunov exponents and fractal correlation dimensions. Comparison of the two sensors is also performed.

EMISSIVITY OF ROCKET PLUME PARTICULATES

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Master of Science in Astronautical Engineering-September 1992
Advisor: David Netzer-Department of Aeronautics and Astronautics

The optical properties of motor aluminum oxide are required inputs to current plume signature prediction codes, such as SIRRM. Accurate predictions are possible only if variations in the particle emissivity due to changes in particle size, contamination, and changing temperature, etc., are known. This investigation demonstrated a simplified method for determination of the emissivity of rocket motor generated alumina. Plume particulate material was collected on tungsten alloy wire during motor firings. A DC circuit was used to resistively heat the material, and the temperature was determined at various points by relating the wire resistivity to circuit current and voltage. An Agema Thermovision infrared (3.5-5 μ) camera and microscope were used to observe the material during heating, and broad-band emissivity was computed using system software. It is estimated that the emissivity could be measured with an accuracy of $\pm$ 3%. Motor alumina was found to have significantly greater emissivity than pure alumina in the temperature range of 500-1200K.

MASTER OF SCIENCE
IN
APPLIED MATHEMATICS

A GRAPH THEORETIC APPROACH TO THE OPTIMAL SLOT UTILIZATION PROBLEM FOR NAVAL COMMUNICATION NETWORKS

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Master of Science in Applied Mathematics-June 1992
Advisor: Craig W. Rasmussen-Department of Mathematics

This paper approaches the optimal slot utilization problem in a Naval Battle Group by modelling ships capable of transmitting on a particular frequency as vertices in a graph, and the relationships between them as edges in that graph. We then analyze the structure of the resultant graph and find an upper bound on the chromatic number of its conflict graph to take into account all possible patterns of interference in determining the minimum number of time slots required, thereby allowing efficient and effective net throughput. Our results include the identification of specific types of graphs in which an exact solution is possible based upon the maximum degree of all vertices in the graph, as well as an algorithm for general graphs which will identify an upper bound on the chromatic number of their conflict graph. Original results are proven, and analysis and examples of the algorithm are provided.

A MULTILEVEL APPROACH TO MINIMAL COST NETWORK FLOWS

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Master of Science in Applied Mathematics-September 1992
Master of Science in Operations Research-September 1992
Advisors: Van Emden Henson-Department of Mathematics &
Richard E. Rosenthal-Department of Operations Research

This thesis presents an exploration of the application of multigrid/multilevel techniques to a non-geometric long transportation problem. An introduction to multigrid is given, and specifics of how it is applied to this minimum cost network flow problem are explored. This research shows that multilevel techniques can be applied to network optimization problems. Further, since a previous restriction is removed by transferring the problem from a physical space to a cost space, the techniques can be applied to a broader range of problems. Both a multilevel V-cycle and a Full Multigrid (FMG) algorithm are implemented. Various strategies for restriction and local relaxation are discussed, and comparisons between the methods are made. Experimental results are given. Directions for future work include investigation of graph theoretic aspects of the problem, implementation of a regular grid overlay of the domain, exploration of a fast adaptive composite (FAC) grid algorithm, and development of a full approximation scheme (FA) algorithm.

HYPERCUBE SOLUTIONS FOR CONJUGATE DIRECTIONS

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Master of Science in Applied Mathematics-December 1991
Master of Science in Computer Sciences-December 1991
Advisors: Uno R. Kodres-Department of Computer Sciences &
William B. Gragg-Department of Mathematics

As computing machines advance, new fields are explored and old ones are expanded. This thesis considers parallel solutions to several well-known problems from numerical linear algebra, including Gauss Factorization and the method of Conjugate Gradients. The Gauss algorithm was implemented on two parallel machines: an Intel iPSC/2, and a network of INMOS T-800 transputers. Interprocessor communication -- in both cases -- was borne by a hypercube interconnection topology. The results reveal general findings from parallel computing and more specific data and information concerning the systems and algorithms that were employed. Communication is timed and the results are analyzed, showing typical features of a message passing system. System performance is illustrated by results from the Gauss codes. The use of two different pivoting strategies shows the potential and the limitations of a parallel machine. The iPSC/2 and transputer systems both show excellent parallel performance when solving large, dense, unstructured systems. Differences, advantages, and disadvantages of these two systems are examined and expectations for current and future machines are discussed.

WAVE PROPAGATION IN ELASTIC SOLIDS

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Advisors: Clyde Scandrett & Van Emden Henson-Department of Mathematics

This thesis presents a model which simulates the scattering from a fluid loaded I-beam and the resultant behavior due to fluid-structure interaction. Chapter I gives an overview of the problem and describes the characteristics of the solid and fluid, the aspects of periodicity, boundary conditions and the coupling of the two media. The governing equations of motion are scaled in Chapter II. In Chapter III, the finite-difference formulae for these equations are derived, as is the non-local radiation boundary condition. Difference formulas for typical boundary points of the solid and corner nodes are also derived. All finite difference formulae used are presented in Appendix C. Chapter IV contains numerical results. Conclusions are drawn and areas of the problem that would require further study are in Chapter V.

PARALLELIZATION OF THE NAVAL SPACE SURVEILLANCE CENTER (NAVSPASUR) SATELLITE MOTION MODEL

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The Naval Space Surveillance Center (NAVSPASUR) uses an analytic satellite motion model based on the Brouwer-Lyddane theory to assist in tracking over 6000 objects in orbit around the Earth. The satellite motion model is implemented by a Fortran subroutine, PPT2. Due to the increasing number of objects required to be tracked, NAVSPASUR desires a method to reduce the computation time of this satellite motion model. Parallel computing offers one method to achieve this objective. This thesis investigates the parallel computing potential of the NAVSPASUR model using the Intel iPSC/2 hypercube multi-computer. The thesis develops several parallel algorithms for the NAVSPASUR satellite motion model using the various methods of parallelization, applies these algorithms to the hypercube, and reports on each algorithm's potential reduction in computation time. A diskette containing the Fortran software developed is available upon request from neta@boris.math.nps.navy.mil.

INTRODUCTION TO REAL ORTHOGONAL POLYNOMIALS

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Advisor: Ismor Fischer-Department of Mathematics

The fundamental concept of orthogonality of mathematical objects occurs in a wide variety of physical and engineering disciplines. The theory of orthogonal functions, for example, is central to the development of Fourier series and wavelets, essential for signal processing. In particular, various families of classical orthogonal polynomials have traditionally been applied to fields such as electrostatics, numerical analysis, and many others. This thesis develops the main ideas necessary for understanding the classical theory of orthogonal polynomials. Special emphasis is given to the Jacobi polynomials and to certain important subclasses and generalizations, some recently discovered. Using the theory of hypergeometric power series and their q-extensions, various structural properties and relations between these classes are systematically investigated. Recently, these classes have found significant applications in coding theory and the study of angular momentum, and hold much promise for future applications.

MASTER OF SCIENCE
IN
APPLIED SCIENCE

MATHEMATICAL MODEL AND COMPUTER ALGORITHM FOR TRACKING COASTAL STORM CELLS FOR SHORT-TERM TACTICAL FORECASTS

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Advisor: Carlyle H. Wash-Department of Meteorology

An algorithm has been developed for near real-time forecasting of precipitation storm cell movement over water. The key to the algorithm is the Kalman filter tracking model which is continually updating the mean value and error covariance matrix of a cell's centroid position from past measurements. The algorithm was developed and applied to precipitation cells to evaluate the advantages of utilizing an optimal recursive processing program to assist in making short-term tactical forecasts. All of the real-time tracking data was detected by a land-based radar system. The thesis results suggest that for short-term forecasting the Kalman filter can produce some improvements over other tracking models, but further refinement in identifying the storm cell center and mathematically identifying the area of extent of each individual cell is needed. Other possible improvements to the tracking algorithm might include a methodology to identify what meteorological parameters need to be included in the motion mode. Incorporating those parameters into the Kalman error matrices will produce substantial improvements to the present storm cell tracking programs. An examination of the Kalman tracker predictions and the storm cell's radar position reveal a mean prediction centroid error for 30 minute predictions of approximately 5.81 km with a standard deviation of 3.64 km.

AN EVALUATION OF THE ASSET CAMPAIGN MODEL IN A REGIONAL ANTISUBMARINE WARFARE CONTEXT

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Master of Science in Applied Science-September 1992
Advisor: James N. Eagle-ASW Academic Group

This thesis looks at the Antisubmarine Warfare Systems Evaluation Tool (ASSET), written by Metron, Incorporated for OP-71, and how it relates to a current threat environment. ASSET is a campaign level ASW Monte-Carlo simulation intended for developing ASW Master Plans, top-level war fighting requirements (TLWRs), appraisals and assessments. ASSET, delivered in 1990, was written from a U.S.-Soviet conflict perspective, and needs some restructuring to be able to provide conflict Measures of Effectiveness using platforms that are expected in a regional war. Included as suggested improvements are: a conventional submarine addition with major emphasis on power plant capabilities and limitations; improvements to the surface group-submarine interaction; and improvements and additions to the methods of detection available to the objects in simulation.

SENSITIVITY OF THE TOMOGRAPHIC INVERSE SOLUTION TO ACOUSTIC PATH VARIABILITY

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As part of the Greenland Sea Project Woods Hole Oceanographic Institution and Scripps Institute of Oceanography deployed six acoustic tomography transceiver moorings to measure variability of the Greenland Sea gyre through a cooling cycle from September 1988 to August 1989. Using a set of Greenland Sea acoustic tomography data provided by Woods Hole Oceanographic Institution this thesis investigated the importance of incorporating acoustic path changes in the construction of the tomographic inverse solution. A comparison of the inverse solutions for changes in sound speed using non-corrected and corrected acoustic multipaths was conducted. Although the two inverse solutions are qualitatively similar, significant quantitative differences exist. These differences indicate that it is necessary to account for changes in the acoustic multipaths for the generation of accurate Greenland Sea acoustic tomography maps.

MODELING CONVERGENCE ZONE GAIN ON MS-DOS-BASED PERSONAL COMPUTERS

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Advisor: Alan B. Coppens-Department of Physics

The models for determining convergence zone Gain (G) were developed using a linearized Sound Speed Profile (SSP) and applying ray tracing theory. The SSP was divided into three cases; bilinear, bilinear with isospeed layer, and bilinear with mixed layer. Two analytical solutions were developed using Taylor series and binomial series expansions to determine G, one for the bilinear and bilinear with isospeed layer, and the other for the bilinear with a mixed layer. The solutions for G are exclusively a function of the SSP gradients. Each solution was compared to the solutions from ray tracing and the solutions from the Integrated Carrier ASW Prediction System (ICAPS) (which runs on mainframe computers and requires more data in addition to the SSP). When the SSP's were not too unusual, the solutions for G were fairly close when compared to ray tracing and ICAPS.

STUDY OF PLANE WAVE IMPINGEMENT ON A THIN PLATE CAPABLE OF DEFORMATION

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This thesis Models the effects in a fluid medium of a plane wave that has impinged upon a reinforced plate. The wave equation for pressure, and the equation of a thin plate combined with other equations are coupled at the interface between the fluid and the thin plate. The actual modeling is accomplished in a FORTRAN computer program written to run on the Naval Postgraduate School's mainframe computer. The program uses extensive finite differencing on a domain, assumed to be a small section of an infinite interface between the fluid and the plate, to simulate the deflection of the thin plate and the pressure disturbances in the fluid medium. To accomplish this, each of the above equations are scaled or nondimensionalized. Additional finite differencing is explained which covers the special cases for the side boundaries of the fluid domain and the artificial boundary created to model infinity. Different beam spacing is explored for its effect on the magnitude of the propagating modes of the scattered pressure wave.

EXTENSION OF THE ANALYTICAL APPROXIMATION TO THE TRANSMISSION OF SOUND IN SHALLOW WATER USING THE IMAGE MODEL

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An analytical approximation to the image theory model is developed for predicting the acoustical pressure field in a wedgeshaped ocean. This thesis is a continuation of the ongoing development of this model. Previously, limitations has restricted the source and receiver to be placed in only an upslope/downslope configuration. This thesis removes these limitations and allows the source and the receiver to be placed in cross-slope configuration.

AN EVALUATION OF OPEN OCEAN SCREEN GEOMETRIES FOR CARRIER BATTLEGROUP TRANSITS UNDER THE 1990s THREAT

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M.B.A., University of Maryland, 1987
Master of Science in Applied Science-June 1992
Advisors: Michael P. Bailey & Peter A. W. Lewis-Department of Operations Research

A simulation model was specified. It examines United States Navy Antisubmarine Warfare Screen alternative dispositions for Carrier Battlegroups. The scenario posed is open ocean transit under the threat of an attack from foreign submarine hulls built in the 1990s. The investigation raises the issue of the appropriateness of current Navy practices and suggests that new tactics be developed. The author's thoughts are that in the 1990s there will be ever newer, more lethal, unpredictable threats to United States' maritime independence than current doctrine addresses. THE FULL IMPLEMENTATION OF THE SIMULATION PROGRAM HAS NOT BEEN ACCOMPLISHED. A segment of verification output is shown for expository purposes only. A discussion is given on the adequacy of the model's abstractions along with their possible impact on potential results of experiments.

OPTIMAL LINEAR ARRAY HEADING IN A DIRECTIONAL NOISE FIELD

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Master of Applied Science-September 1992
Advisor: Alan Coppens-Department of Physics

This thesis discusses a procedure that optimizes the signal-to-noise ratio (SNR) detected by a linear array in a directional ambient noise field. The SNR can be optimized by minimizing the ambient noise detected by the array. For a given target location, each possible heading of the array centers the ambiguous beam of the array at a different true bearing. Therefore, each heading of the array will receive a different ambient noise level. An optimal heading can be obtained which maximizes the SNR received by the array. For all possible headings the beam pattern of the array must be determined and combined with the ambient noise field to determine the noise level detected. This thesis discusses the theory involved in calculating the ambient noise levels detected for each heading and provides a computer program which performs the calculations for a particular array.

FEASIBILITY FOR THE INTEGRATION OF ASW INFORMATION DATABASES

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Master of Science in Applied Science-September 1992
Advisor: Daniel Dolk-Department of Information Systems

There are currently three databases supported by three different commands that collect and output similar ASW information: PACER, AIREM, and SHAREM. These databases contain initial detection data, tracking data, environmental data, system performance data, and weapon performance data. This thesis investigates the commonalities and differences in structure and content of the three databases, and examines the feasibility of integrating PACER, AIREM, and SHAREM into a single database. The benefits of this database integration are a more comprehensive utilization of data, reduced data collection for fleet users, and a standardization of how the data is utilized.

BROADBAND MODAL BEAMFORMING OF ACOUSTIC TOMOGRAPHY SIGNALS ACQUIRED BY A VERTICAL ARRAY

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B.S.E.E., Virginia Military Institute
Master of Science in Applied Science-September 1992
Advisor: James Miller-Department of Electrical and Computer Engineering

The objective of this thesis is to develop a technique and associated algorithms to extract the arrival time of modal energy, using a vertical array, from broadband signals. Modal energy arrival time is important to shallow water acoustic tomography because low angle rays, which contain the majority of acoustic energy, are often not resolvable. Tilt compensation is included in the beamforming algorithm to provide a virtual vertical array. A broadband modal filtering technique is accomplished through weighting the frequency components of phase encoded tomographic signals by the spectrum of the mode shapes. A methodology of phase decoding after beamforming was adopted to minimize processing. Initial development and prototyping was done using a parabolic equation model. Further testing was accomplished on real data taken from the Barents Sea Polar Front Experiment, August 1992. Results show consistency over a number of transmitted pulses. Mode energy travel time measurement is simplified due to the distinct arrival structure of beamformed signals. Based on these results, the modal beamforming algorithm should be a useful tool for acoustic tomography.

UTILIZATION OF THE NAVY'S EXISTING ASW DATABASES

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Master of Science in Applied Science-September 1992
Advisor: Judith Lind-Department of Operations Research

The Navy's antisubmarine warfare (ASW) information support system consists of many databases and Naval commands located throughout the United States. The structure and current uses of the information support system were examined to determine the key elements related to effective ASW database utilization. A 28-question survey was administered to 45 Naval commands from both the tactical and research and development communities to determine the current uses of ASW-related information, current and future data requirements, and opinions of how the information support system could be improved to increase its usefulness. The critical factors derived from survey responses include specific time requirements to distribute information, requirements for standard data formats and database equipment, and requirements for increased database accessibility. Recommendations are made to commands involved with improving the information support system (OP-94, OP-71, and NUWC detachment, Hawaii).

A CATEGORICAL ANALYSIS OF WEAPON SYSTEM ACCURACY TRAIL (WSAT) DATA

Brian F. Philipp-Lieutenant Commander, United States Navy
Master of Science in Applied Science-September 1992
Advisor: Wayne Hughes-Operations Research Department

This thesis contains an analysis of the last five years of Antisubmarine Warfare (ASW) Weapon System Accuracy Trial (WSAT) data from both the Atlantic and Pacific Fleet. The analysis is conducted in an effort to provide recommendations to be applied toward future evolution of the ASW Test Program for surface ships. A statistical chi-square test is conducted on Fleet and Navy wide data to determine which ASW combat system material categories are most prone to degradation. Additionally, a critical examination of the existing WSAT data base is provided with an aim toward promoting future statistical analysis. Results of this thesis indicate that degradation to weapons delivery systems like torpedo tubes and ASROC launchers is statistically more significant than the other WSAT test categories. The thesis also recommends new ways to adapt the existing WSAT data base to conduct more informative inspections of existing and new construction ships.

CONTINUED INVESTIGATION OF THE USE OF PASSIVE RESONATORS TO IMPROVE THE PERFORMANCE OF A LOW FREQUENCY SONAR TRANSDUCER

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B.S.E.E., North Carolina State University, 1985
Master of Science in Applied Science-December 1991
Master of Science in Engineering Acoustics-December 1991
Advisor: Steven R. Baker-Department of Physics

In an earlier thesis, Ellsworth showed that the radiated power output (quantified by the gain in radiation resistance presented to the transducer) and directivity of a compact underwater transducer can be significantly improved by the use of a system of resonant scatterers. These resonant scatterers were termed "sympathetic resonators." In the present work, we verify the previous findings and extend the work to additional cases of interest. Specifically, we (1) employ equations requiring fewer assumptions and implement them using more accurate numerical techniques, (2) reproduce Ellsworth's calculations and provide graphical results for conical and planar circular configurations for the case of six passive acoustic resonators, (3) extend the theory to and provide results for two types of linear arrays of passive acoustic resonators, (4) and finally, we consider acoustic Yagi-Uda antenna-like configuration of passive acoustic resonators to improve the directivity of an underwater transducer. The results indicate that the conical configuration of six resonators is the best choice in terms of the gain in radiated power output, directivity along an acoustic axis, and minimum required number of resonators.

A METHODOLOGY FOR DETERMINING THIRD WORLD SUBMARINE CAPABILITIES CASE STUDY: IRAN

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B.S., United States Naval Academy, 1985
Master of Science in Applied Science-September 1992
Advisor: Kneale Marshall-Department of Operations Research

This thesis presents a method to determine the capabilities of an emerging Third World submarine force. As a "primer," it examines the major factors which contribute to the operational readiness and military effectiveness of a submarine force. The areas discussed are national characteristics, research and development, equipment, training, and operations. The scope of the thesis is very broad in nature, and covers topics as varied as preventive maintenance, spare parts production, and crew training. The areas are analyzed with respect to their importance in estimating the submarine force's missions and capabilities. The penultimate chapter of the thesis uses the methodology to consider the significance of the Iranian acquisition of two *Kilo* submarines from Russia. The methodology is condensed (in the Appendix) to a checklist for use while evaluating an emerging submarine force.

MASTER OF SCIENCE
IN
COMPUTER SCIENCE

PATH TRACKING USING SIMPLE PLANAR CURVES

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Master of Science in Computer Science-March 1992
Advisor: Yutaka Kanayama-Department of Computer Science

This thesis presents a method of controlling an autonomous vehicle's motion in a two dimensional environment. Its purpose is to expand the functionality of a vehicle's motion by complementing a point-to-point path planning scheme with a path-to-path scheme. The method introduced in this paper will use the vehicle's position and the desired path to calculate the necessary curvature to effect movement onto the desired reference path. The reference path will be a simple planar curve, such as, a circle or line. After successful testing of an operating algorithm, the method shall be incorporated into a robot's software system. This path tracking method will lay the groundwork for a dynamic obstacle avoidance system for a mobile robot.

DESIGN AND IMPLEMENTATION OF A GRAPHICAL USER INTERFACE FOR A MULTIMEDIA DATABASE MANAGEMENT SYSTEM

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Turkish Naval Academy, 1986
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and
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The purpose of this thesis was to design and implement a graphical user interface for a multimedia database management system prototype previously implemented at the Naval Postgraduate School. Because of complexity of data types and difficulty of manipulating them, it was very hard for a casual user to use the previous system. Since graphical interaction simplifies control dialogue, we designed and implemented a graphical user interface using C++ and InterViews 3.0.1 for a Sun-3 workstation under Unix X-Windows environment with mouse support. We then connected this interface to the multimedia database system prototype. Our interface supports incremental query specification using extended SQL and can be connected to database applications in several different ways. An embedded global data structure, a text file or character string can be used for connections. A second version of the interface for a Sun-4 workstation was built and connected to another database system using the character string and text file. This version demonstrated even better performance.

THE INTEGRATION SYSTEM FOR THE LOW-COST COMBAT DIRECTION SYSTEM

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In a world where changes in technology occur each minute, the demand for a hard Real-Time embedded computer system deployed on board naval ships not equipped with Naval Tactical Data System increases. As the demand increases, an important fact looms, a new approach to software development and system design is essential. The approach used in our research started with the requirement specifying use of Ada as the design language with UNIX as the operating system, and selection of the commercial workstation rugged enough to withstand shipboard requirements. The system requires standard power with no special interface equipment for adaptation to shipboard application. Specific benefits include ease of maintenance and expansion of ongoing processes and applications, allowing the system to grow as the need grows. This study provides a detailed set of requirements, functional specifications, designs, and a prototype implementation of the Integration System for such a system. The approach taken is to implement the basic features of a Combat Direction System (CDS) on a commercially available microprocessor workstation. This Integration System for the Low Cost Combat Direction System meets all the requirements specified by the Naval Sea Systems Command. The code provides the basic elements and is designed for integration of a database, a user interface, and the ships sensors necessary to provide essential data to operate the system.

NPS AUV INTEGRATED SIMULATOR

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The development and testing of Autonomous Underwater Vehicle (AUV) hardware and software is greatly complicated by vehicle inaccessibility during operation. Integrated simulation remotely links vehicle components and support equipment with graphics simulation workstations, allowing complete real-time, pre-mission, pseudo-mission and post-mission visualization and analysis in the lab environment. Integrated simulator testing of software and hardware is a broad and versatile method that supports rapid and robust diagnosis and correction of system faults. This method is demonstrated using the Naval Postgraduate School (NPS) AUV. High-resolution three-dimensional graphics workstations can provide real-time representations of vehicle dynamics, control system behavior, mission execution, sensor processing and object classification. Use of well-defined, user-readable mission log files as the data transfer mechanism allows consistent and repeatable simulation of all AUV operations over a distributed network of workstations. Integrated simulation is also useful for development of the variety of sophisticated artificial intelligence applications needed by an AUV. Examples include sonar classification using an expert system and path planning using a circle world model. The flexibility and versatility provided by this approach enables visualization and analysis of all aspects of AUV development. Integrated simulator networking is recommended as a fundamental requirement for AUV research and deployment.

THREE-DIMENSIONAL PATH PLANNING FOR THE NPS II AUV

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The Naval Postgraduate School in Monterey, California is currently working on an ongoing project for research in autonomous underwater vehicle (AUV) technology. This project comprises two areas of research. The first area is research conducted on the system, NPS II AUV. The second area is a computer simulation of the actual system. One topic which is vital to both areas is three-dimensional path planning. The concept of three-dimensional path planning is on the order of magnitude of polynomial time and current research in this area is limited. This paper reviews my findings and submits an algorithm which finds a best path in a three-dimensional environment, while avoiding all known polyhedral obstacles. The algorithm's concept is to reduce the three-dimensional world to a series of two-dimensional representations, allowing the algorithm to use tangential lines created from the start to nodes on the polygons lying between the start and goal, from nodes on polygons to other polygon nodes and finally, from polygon nodes to the goal.

TELECOMMUNICATIONS TRENDS

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Elisha Gray may have had as much a claim on the invention of the telephone as did Alexander Graham Bell. Bell's patents allowed time for the Bell System to be developed and led to AT&T becoming the largest and most organized telephone company in the United States. AT&T, supported by government regulators, enveloped smaller telephone companies and controlled 80% of local service and all toll service by the 1920s. Government regulations supported AT&T's control of the Nation's telephone network until the 1950s when the industry began to be deregulated. In 1984 AT&T was divested by court order and today's telecommunications market is characterized by continuing deregulation and increasing competition. Both telephone and data transmission are becoming more digital and service is provided by numerous carriers. New techniques for increasing the speed of data transfer are constantly being developed. Applications in the future will require much larger capacities than at present. Optical fiber will be the media used to bring greater bandwidth to homes and businesses. Communication will develop into a universal, personal, and portable capability.

EVALUATION AND IMPROVEMENT OF THE ASW SYSTEM EVALUATION TOOL

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The Antisubmarine Warfare System Evaluation Tool (ASSET) is a generic high-level antisubmarine warfare (ASW) modeling tool, designed to aid ASW personnel in the development and refinement of ASW top-level warfare requirements and the ASW Master Plan. The primary objective of this thesis is to analyze and implement the improvements suggested in previous evaluations of various sub-areas of ASSET. The glimpse rate model for submarine detection used in ASSET has been substituted with compound Lambda-Sigma jump model. There is a different target radiated frequency in each environmental region. Each target will have its own detection rate to reflect the differences in its operating characteristics. Multiple engagements between platforms are used to eliminate the limitations of interaction between opponent platforms. The glimpse rate model is used to determine detection opportunities of maritime patrol aircraft (MPA) and to approximate a continuous-looking sensor pattern. A different criterion of selecting search probability area (SPA) and MPA pairs using the ratio of MPA's time on-station over the SPA size was implemented. The feasibility of converting current ASSET code to CLOS was investigated. In addition, part of the code was converted to CLOS.

USING OBJECT-ORIENTED DATABASES FOR IMPLEMENTATION OF INTERACTIVE ELECTRONIC TECHNICAL MANUALS

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Computer-aided Acquisition and Logistic Support (CALS) is a Department of Defense (DoD) and industry strategy to transition from paper-intensive acquisition and logistic processes to a highly automated and integrated mode of weapon system and operation. A newly demonstrated technology in the context of the CALS initiative is the Interactive Electronic Technical Manual (IETM), which is a portable computer system developed for the use of technicians maintaining weapon systems. The introduction of IETM systems will relieve the technician from the need to carry extensive volumes of hard-copy technical manuals, provide him with easy interactive access to the required technical data and is expected to have a profound impact on the way weapon systems maintenance is conducted and the costs associated with it. Object-Oriented Database Management Systems (OODBMS) is a new technology that marries the characteristics of object-oriented programming languages and data persistence provided by database systems. This thesis explores issues related to the utilization of OODBMS for the implementation of IETM databases, discusses the benefits of this approach and addresses some architectural issues of OODBMS in the context of IETM implementation.

MINEFIELD SEARCH AND OBJECT RECOGNITION FOR AUTONOMOUS UNDERWATER VEHICLES

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Autonomous Underwater Vehicles (AUV) are an outstanding minefield search platform. Because of their stealthy nature, AUVs can be deployed in a potential minefield without the enemy's knowledge. They also minimize dangerous exposure to manned and more expensive naval assets. This thesis explores two important and related aspects of AUV minefield search: exhaustive sensor coverage of minefield through effective path planning and underwater object recognition using the vehicle's sensors. The minefield search algorithm does not require *a priori* knowledge of the world except for user-defined boundaries. It is a three-dimensional, prioritized graph search using a ladder-based methodology and an A* optimal path planning algorithm. The minefield search algorithm effectively ignores areas which are blocked by obstacles, performs terrain following and avoids local minima problems encountered by other area search solutions. The algorithm is shown to be effecti[illegible]g a variety of graphical simulators. The object recognition algorithm provides autonomous classific[illegible] underwater objects. It uses geometric reasoning and line fitting of raw sonar data to form geometric pri[illegible]s. These primitives are analyzed by a CLIPS language expert system using heuristic based rules. The resulting classifications may be used for higher level mission planning modules for effectively conducting the minefield search. Actual NPS AUV swimming pool test runs and graphic simulations are used to demonstrate this algorithm which was built in cooperation with Lieutenant Commander Donald P. Brutzman, USN.

NPSNET: FLIGHT SIMULATION DYNAMIC MODELING USING QUATERNIONS

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The Naval Postgraduate School (NPS) has actively explored the design and implementation of networked, real-time, three-dimensional battlefield simulations on low cost, commercially available graphics workstations. The most recent system, NPSNET, has improved in functionality to such an extent, that it is considered a low cost version of the Defense Advanced Research Project Agency's (DARPA) SIMNET system. In order to reach that level, it was necessary to economize in certain areas of the code so that real-time performance occurred at an acceptable level. One of those areas was in aircraft dynamics. However, with "off-the-shelf" computers becoming faster and cheaper, real-time and realistic dynamics are no longer an expensive option. The realistic behavior can now be enhanced through the incorporation of an aerodynamic model. To accomplish this task, a prototype flight simulator was built that is capable of simulating numerous types of aircraft simultaneously within a virtual world. Beside being easily incorporated into NPSNET, such a simulator will also provide the base functionality for the creation of a general purpose aerodynamic simulator that is particularly useful to aerodynamic students for graphically analyzing differing aircraft's stability and control characteristics. This system is designed for use on a Silicon Graphics workstation and uses the GL libraries.

NPSNET: AURAL CUES FOR VIRTUAL WORLD IMMERSION

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NPSNET is a low-cost visual and aural simulation system designed and implemented at the Naval Postgraduate School. NPSNET is an example of a virtual world simulation environment that incorporates real-time aural cues through software-hardware interaction. In the current implementation of NPSNET, a graphics workstation functions in the sound server role which involves sending and receiving networked sound message packets across a Local Area Network, composed of multiple graphics workstations. The network messages contain sound file identification information that is transmitted from the sound server across an RS-422 protocol communication line to a serial to Musical Instrument Digital Interface (MIDI) converter. The MIDI converter, in turn relays the sound byte to a sampler, an electronic recording and playback device. The sampler correlates the hexadecimal input to a specific note or stored sound and sends it as an audio signal to speakers via an amplifier. The realism of a simulation is improved by involving multiple participant senses and removing external distractions. This thesis describes the incorporation of sound as aural cues, and the enhancement they provide in the virtual simulation environment of NPSNET.

HYPER-NPSNET: A VIRTUAL WORLD WITH AN INTEGRATED 3D HYPERTEXT

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This thesis proposes an extension to the NPSNET 3D virtual world prototype to provide an integrated 3D hypertext. This hypertext would be embedded into the virtual world, and would provide the capability for real-time or non-real-time reference, aspect-change within or around vehicles, direct navigation to a specified 3D location, and other features. Hypermedia such as video or graphic animations, with or without sound, in addition to text files will be accessible through the hypertext. The hypertext elements will be embedded into the virtual world by the use of icons or other symbols, which become visible if selected by the user. Foreseeable applications include hypernavigation, historical reference visualization, direct access to higher-level analysis functions, and contextural referencing for training applications. A prototype of Hyper-NPSNET is planned for initial review in June 1992.

ITS ADA: AN INTELLIGENT TUTORING SYSTEM FOR THE ADA PROGRAMMING LANGUAGE

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Most tutoring systems are machine dependent. In this thesis we present an intelligent tutoring system, *ITS Ada*, that exploits the designed portability of Ada. *ITS Ada* possesses full knowledge of Ada as defined in the official language reference manual and consists of four major components. The instructional module is a series of screens presented in an order determined by a topic network that covers the complete set of concepts in the Reference Manual for the Ada Programming Language. Superordinate concepts will be presented only after the prerequisite concepts have been mastered. There are exercise problems associated with each topic. The problems are presented by the diagnostic module in either an expository or interrogatory format, based on the student's mastery level for that concept, as determined by the student module. Solutions to the given problems are checked by parsing the student's response into a meaning list and comparing the results with solutions in the expert module. *ITS Ada* has been tested on three platforms: PC/InterAda, Sun SparcStation/Verdix Ada, and Apple Macintosh/Meridian Ada. We believe it can be run on any system with a validated Ada compiler.

ON INCREASING THE EFFECTIVE BLOCKING FACTOR OF A MATRIX FOR A GIVEN CACHE ORGANIZATION

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Blocking (Tiling) techniques of iteration spaces to increase data reuse in the cache were reviewed. Results consistent with those previously published were experimentally obtained. The relation between the sizes of the declared matrix and the cache was studied. Based on this relation, two algorithms were presented. Both algorithms attempt to increase the critical blocking factor with no self-interference (B_c) by changing the declared matrix size. Furthermore, the execution time of the second algorithm is independent of the matrix size. Experiments based on these algorithms were performed which showed a consistent superior performance (in terms of Mflops) relative to the performance obtained using previously published algorithms for deriving B_c.

THE DESIGN AND IMPLEMENTATION OF A USER INTERFACE FOR THE COMPUTER-AIDED PROTOTYPING SYSTEM

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The Computer Aided Prototyping System (CAPS) is a software tool intended to make the software development cycle more efficient. Through the use of prototyping, the functional requirements for an embedded system can be quickly validated before wasting resources on an inadequate design. As CAPS is composed of separate tools, the user interface must tie these separate programs together into one coherent tool easily used by a software engineer. This thesis discusses the design and implementation considerations involved in creating an improved user interface for CAPS. The new interface is simpler for the user to use and configure. It is also easier for the system administrator to make changes as tools are added to the system and improved. The new interface also tightly couples the Prototype System Description Language (PSDL) syntax-directed editor to the graph editor, and enables automatic propagation of constraints between the two. The final design is presented, along with the implementation. The thesis also contains a manual for using the system as well as a programmer's manual.

THE DEVELOPMENT OF A DESIGN DATABASE FOR THE COMPUTER-AIDED PROTOTYPING SYSTEM

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M.B.A., Webster University, 1983
Master of Science in Computer Science-March 1992
and
Garry Wayne Lewis-Major, United States Marine Corps
B.A., University of Virginia, 1974
M.B.A., Golden Gate University, 1985
Master of Science in Computer Science-March 1992
Advisor: Lucia Luqi-Department of Computer Science

The Computer Aided Prototyping System (CAPS) was created to rapidly prototype real-time systems to determine early in the development cycle whether system requirements can be met. The CAPS consists of several software tools that automatically generate an executable Ada model of the proposed system. This thesis describes the development of a design database (DDB) for the CAPS. The DDB is an engineering database that contains all information related to a prototype software design. The DDB enhances the *CAPS* environment and the prototyping paradigm by providing to the designer the functions of storage, retrieval, viewing, and versioning of prototype components. Garry Lewis is the primary author of Chapters I and II and Drew Dwyer the primary author of Chapters III and IV. In the joint implementation, Lewis focused on the design database schema and C++/ONTOS issues. Dwyer was responsible for building the command line interface, the hierarchical k-ary data structures and the C++ classes/methods for traversing this structure. Items not covered in the above description were mutually developed.

IMPLEMENTING RELATIONAL OPERATIONS IN AN OBJECT-ORIENTED DATABASE

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Master of Science in Computer Science-March 1992
Advisor: Michael L. Nelson-Department of Computer Science

This thesis expands the concepts of relational/object-oriented databases. There are two different approaches to combining relational and object-oriented databases. This thesis takes the approach of adding relational operations to an object-oriented database rather than building an object-oriented layer on top of an existing relational database. The system proposed in this thesis was developed in the object-oriented programming language Prograph. It was chosen because it contains primitive operations for reading and writing database files to secondary storage and for manipulating complex data types (e.g., sounds, and pictures). This thesis demonstrates that the limitations of current systems can be remedied and that the relational/object-oriented database management system is indeed a feasible solution.

OBJECT-ORIENTED PROGRAMMING: AN ASSESSMENT OF FUNDAMENTAL CONCEPTS AND DESIGN CONSIDERATIONS

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B.A., Economics, Maryland University, 1979
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The latest buzzword penetrating the professional computer science literature is object-oriented programming. Computer scientists extol its virtues while developers explore its potential for streamlining the process of software development. Amidst all this activity there remains substantial confusion about fundamental concepts and the programming language mechanisms which implement these concepts. Too often, students of object-oriented programming mistake proficiency in an object-oriented language for efficient application of object-oriented techniques. The immediate consequence is poorly conceived, sometimes conflicting, efforts at exploiting reusability, information hiding and other object-oriented capabilities. This thesis reviews the benefits attributed to object-oriented programming, arrives at definitions for fundamental concepts, advances recommendations for conducting object-oriented analysis and object-oriented design, and reviews some tradeoffs which designers need to consider when developing object-oriented classes and hierarchies.

THE INSTRUMENTATION OF A PARALLEL, DISTRIBUTED DATABASE OPERATION, RETRIEVE-COMMON, FOR MERGING TWO LARGE SETS OF RECORDS

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B.S., California State University, 1983
Master of Science in Computer Science-June 1992
Advisor: David K. Hsiao-Department of Computer Science

The Naval Postgraduate School's Laboratory for Database Systems Research is the site of the multi-backend database supercomputer (MBDS). Originally, MBDS supported a prototype primary operation (retrieve-common) which merged two sets of records in a distributed, parallel database environment. This thesis presents the testing, and modification of that prototyped primary operation. First, the design rationale of the MBDS is reviewed. Specifically, this review examines the reasons for a database-oriented supercomputer, the MBDS primary processes, and the methodology of distributing a database within loosely coupled and highly parallel database stores. Then, this study explains the methodology involved in developing theories on the cause of retrieve-common's defects and bottlenecks. Finally, in validating our theories, this study relates the process of discovering and correcting these discrepancies.

HYPERCUBE SOLUTIONS FOR CONJUGATE DIRECTIONS

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Master of Science in Computer Science-December 1991
Master of Science in Applied Mathematics-December 1991
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William B. Gragg-Department of Mathematics

As computing machines advance, new fields are explored and old ones are expanded. This thesis considers parallel solutions to several well-known problems from numerical linear algebra, including Gauss Factorization and the method of Conjugate Gradients. The Gauss algorithm was implemented on two parallel machines: an Intel iPSC/2, and a network of INMOS T-800 transputers. Interprocessor communication - in both cases - was borne by a hypercube interconnection topology. The results reveal general findings from parallel computing and more specific data and information concerning the systems and algorithms that were employed. Communication is timed and the results are analyzed, showing typical features of a message passing system. System performance is illustrated by results from the Gauss codes. The use of two different pivoting strategies shows the potential and the limitations of a parallel machine. The iPSC/2 and transputer systems both show excellent parallel performance when solving large, dense, unstructured systems. Differences, advantages, and disadvantages of these two systems are examined and expectations for current and future machines are discussed.

COGNITIVE MODELING AND THE EVOLUTION OF THE STUDENT MODEL IN INTELLIGENT TUTORING SYSTEMS

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This thesis deals with the design and development of a student module for an intelligent tutoring system (ITS). Within the context of this thesis a student module has two components: a student model, and a diagnostic component. We present an in-depth review of the history of ITS, on the design, development, and limitations of the system. We review the methods of cognitive modeling used in some historical systems and a variety of methods of program analysis used in previous works. We also discuss some Ada language issues that are both language specific and compiler specific, and related to tutoring in Ada. Our approach was to take an existing intelligent tutoring system, an Ada language tutor written in Ada, and extend the capabilities of the student module without altering the existing student model or diagnostic package. We designed heuristics to analyze the programming constructs involved in the student learning process and were able to generate information which may indicate the deficiencies and possible causes in the student model. The implementation of this idea required the integration of CLIPS and the Ada programming language. Using a small portion of the Ada language we have successfully diagnosed common programming misconceptions and missing concepts with novice Ada programmers.

HISTORICAL OVERVIEW OF DATA COMMUNICATION WITH ANALYSIS OF A SELECTIVE REPEAT PROTOCOL

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This thesis is primarily divided into two parts. The first part provides an overview of the historical milestones in the development of the telecommunications industry, the computer industry, primarily the hardware technology, and the merging of the two industries. The milestones chosen and the details given were motivated by the current trends regarding the consolidation of the two fields of telecommunications and computers into the area which is referred to as data communications. The second part of the thesis is an analysis of a specification for a data link communications protocol, specifically the sliding window selective repeat protocol. The specification was modeled using the systems of communicating machines. This model uses a combination of finite state machines and variables which allows the size of the specification to be linear in the window size. The analysis used is a system state analysis, similar to the reachability analysis of the pure finite state model. The resulting system state analysis was reviewed for an underlying graph structure. The graph found was defined and an inductive proof developed to extend the analysis of the protocol for a window size of all nonnegative integers w.

IMPROVING SECURITY IN THE FIBER DISTRIBUTED DATA INTERFACE (FDDI) PROTOCOL

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The arrival of high speed packet switched fiber optic LANs has allowed local area design architectures to be used for larger metropolitan area network (MAN) implementations. The current LAN security mechanisms used in larger and faster fiber optic LANs and MANs are often inappropriate or unacceptable for use with emerging applications. The protocol of the Fiber Distributed Data Interface (FDDI) standard provides a natural means for message *integrity* and *availability* verification. However, privacy in FDDI is facilitated at higher layers through a generic LAN standard. This thesis proposes a modification to the FDDI protocol implemented at the medium access control (MAC) sublayer, which integrates a confidentiality mechanism for data transfer. The modification provides a simple comprehensive security package to meet the high performance needs of current and emerging applications. In the proposed modification, the inherent properties of the ring are exploited using a unique Central Key Translator to distribute initial session keys. A symmetric bit stream cipher based on modulo 2 addition is used for encryption/decryption by the transmitting and receiving stations. Part of the plaintext from transmitted message frames is used as feedback to generate new session keys.

A STUDY OF CURRENT WORLD TELECOMMUNICATIONS AND A PROJECTION OF THE FUTURE

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Telecommunications today are an important factor in economic and social progress. The last decades of the 20th century and the early years of the 21st have been characterized by many as the Information Age. Telecommunications, the movement of information through distances, is absolutely critical to the economic progress and military survival of nations. This thesis is an attempt to predict the future of telecommunications, by studying and analyzing the past and present. First it examines the meaning of telecommunications today and some basic ways of information transmission. The current status of world telecommunications is then presented, by examining the regional profiles as they are divided by the International Telecommunication Union. A number of statistical studies are given, which present a thorough picture of the current world telecommunications. In an effort to predict future industry trends, the competition among the three largest telecommunications markets, U.S.A., Japan and European Community is also considered, by looking at their present telecommunications industry, the efforts they make to improve their technology and their plans for future investment. Finally some major technological trends including Broadband ISDN, the use of fiber technology in the telecommunications loop and the use of solitons are examined. The new Metropolitan Area Network protocol, FDDI-II is also reviewed.

THE DEVELOPMENT OF A DESIGN DATABASE FOR THE COMPUTER- AIDED PROTOTYPING SYSTEM

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M.B.A., Golden Gate University, 1985
Master of Science in Computer Science-March 1992
and
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The Computer Aided Prototyping System (CAPS) was created to rapidly prototype real-time systems to determine early in the development cycle whether system requirements can be met. The CAPS consists of several software tools that automatically generate an executable Ada model of the proposed system. This thesis describes the development of a design database (DDB) for the CAPS. The DDB is an engineering database that contains all information related to a prototype software design. The DDB enhances the *CAPS* environment and the prototyping paradigm by providing to the designer the functions of storage, retrieval, viewing, and versioning of prototype components. Garry Lewis is the primary author of Chapters I and II and Drew Dwyer the primary author of Chapters III and IV. In the joint implementation, Lewis focused on the design database schema and C++/ONTOS issues. Dwyer was responsible for building the command line interface, the hierarchical k-ary data structures and the C++ classes/methods for traversing this structure. Items not covered in the above description were mutually developed.

USER INTERFACE OF DFQL: AN OBJECT-ORIENTED APPROACH

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In recent years, many graphical approaches have been proposed to lift the inconvenience of text-based query language among end-users. The new query language called DFQL (DataFlow Query Language) is a fully graphical interface to the relational model based on a dataflow paradigm. It only requires users to connect some well-defined operators which have been given an equivalent one-to-one correspondent functionality (or construct) in traditional query language (SQL in this case). All of the power of current query languages and sufficient expressive power and functionality are retained. But some shortcomings of DFQL user interface still exist. This thesis is to introduce a more easy-to-use and easy-to-learn user interface, so the shortcomings we found in DFQL user interface can be lifted and the productivity and power of the new version of DFQL can be increased. We have adopted object-oriented programming approach in our implementation and the benefits of using object-oriented programming in our development are also discussed.

TURTLE GRAPHICS IMPLEMENTATION USING A GRAPHICAL DATAFLOW PROGRAMMING APPROACH

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This thesis expands the concepts of object-oriented programming to implement a visual dataflow programming language. The main thrust of this research is to develop a functional prototype language, based upon the Turtle Graphics tool provided by LOGO programming language, for children to develop both their problem solving skills as well as their general programming skills. The language developed for this thesis was implemented in the object-oriented, dataflow programming language Prograph. The dataflow paradigm was emulated in order to provide a more intuitive, easy to learn programming environment for children to use. Additionally, Prograph was chosen because it provides the necessary base classes to easily implement an interactive user interface, and it provides the necessary primitive operations for all graphics drawing routines. This thesis demonstrates a prototype for a potential visual programming language that can be used at all levels of education to teach problem solving, higher-order thinking skills, mathematical concepts, and the fundamentals of computer science.

THE DESIGN AND IMPLEMENTATION OF A FUNCTIONAL INTERFACE FOR THE ATTRIBUTE-BASED MULTI-LINGUAL DATABASE SYSTEM

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Advisor: David K. Hsaio-Department of Computer Science

Traditionally, the design and implementation of a conventional database system begins with the selection of a data model, followed by the specification of a model-based data language. Hence, the database system is restricted to a single data model and a specific data language. One alternative to this traditional approach to database-system development is the multi-lingual database system (MLDS). This alternative approach affords the user the ability to access and manage a large collection of databases, via several data models and their corresponding data languages, without the aforementioned limitations. This thesis presents a methodology for supporting the Functional Data Model and the Data Language DAPLEX for the MLDS. Specifically, we design an interface which translates DAPLEX data language calls into attribute-based data language (ABDL) requests. A description of the software engineering aspects of the implementation and an overview of the modules which comprise our DAPLEX language interface are provided.

CONCEPT FLOW DIAGRAMS: METHOD FOR DESIGN OF COMPUTER-AIDED INSTRUCTION

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Master of Science in Computer Science-March 1992
Advisor: Timothy J. Shimeall-Department of Computer Science

Current software design techniques are organized around either data transformation or stimulus-response control flow abstractions. Neither of these approaches apply to the flow of presentation and answer analysis that characterizes computer-aide instruction. This thesis introduces a new design abstraction, concept-flow, and technique that exploits it in the design of tutorial software. The design technique uses concept-flow diagrams, which highlight presentation of information and verification of user comprehension. The technique is explained through application to a tutorial on the physics of underwater sound. The design and implementation of a prototype concept-flow interpreter are presented. This design technique and the associated interpreter allow for rapid construction of highly flexible computer-based tutorial strategies, useful for both traditional CAI applications and for more efficient help-sequence design in interactive systems.

DESIGN AND SPECIFICATION OF A HIGH SPEED TRANSPORT PROTOCOL

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Master of Science in Computer Science-March 1992
Advisor: G.M. Lundy-Department of Computer Science

Due to the increase in data throughput potential provided by high speed (fiber optic) networks, existing transport protocols are becoming increasingly incapable of providing reliable and timely transfer of data. Whereas in networks of the past it was the transmission medium that caused the greatest communications delay, it is the case today that the transport protocols themselves have become the bottleneck. This thesis provides detailed insight into the issues that are affecting the development of the next generation of high speed transport protocols, and includes a formal specification and limited analysis of one such protocol. Through a dissection of transport protocol functions, this thesis illustrates some of the problems which are hindering optimal performance, and demonstrates some of the design considerations of new transport protocols which are providing significant gains in efficiency. Three of the most promising lightweight transport protocol research projects are surveyed to provide a frame of reference for the newly emerging design paradigm: taking advantage of the low error rate of fiber optic media to optimize success, rather than compensate for failure.

INCORPORATION OF GPS/INS INTO SMALL AUTONOMOUS UNDERWATER VEHICLE NAVIGATION

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Master of Science in Computer Science-March 1992
Advisor: Sehung Kwak-Department of Computer Science

Navigation of an Autonomous Underwater Vehicle (AUV) is a problem that has not been adequately solved. Although the inclusion of the Global Positioning System (GPS) into AUV navigation has been briefly examined before, this possibility is explored further in this thesis. GPS and Inertial Measurement System (INS) based navigation package offers many advantages for AUV navigation especially for transits and precise object location in shallow water. This thesis provides background information on GPS and INS as they pertain to small AUV employment. The use of the GPS/INS navigation package for AUV transits and precise object location work is presented. Two designs with specified components are developed. A GPS receiver was tested for AUV employment suitability. These test results are presented and analyzed.

NPSNET: MODELING THE IN-FLIGHT AND TERMINAL PROPERTIES OF BALLISTIC MUNITIONS

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Graphical computer simulations provide a means through which weapon prototyping and tactical evaluations can be conducted at low cost, without the risks associated with the movement of equipment and firing of weapons. Because of the widespread use of ballistic munitions in the armed forces, a fundamental aspect of the implementation of such military simulations is a physical model that governs ballistic behavior. The modified point-mass trajectory model is used to implement ballistic trajectories with NPSNET, a real-time, graphical, three-dimensional simulation. A parallel algorithm is used to simulate the visual characteristics of shrapnel-producing explosions. A special case of ballistic trajectories involves the application of indirect fires. When a projectile travels along a curved path to the target area, rather than being propelled directly along the line of sight, much greater ranges can be achieved. This makes it possible to fire upon an enemy without directly exposing the firing elements to harm. As a result of these increased ranges, it is generally not possible for the firing element to acquire its own targets. Thus, an additional player is required to represent this tactic in a virtual world: the forward observer. An expert system is presented that mimics the cognitive contributions of a human forward observer.

VERSION AND VARIATION CONTROL OF A DESIGN DATABASE FOR A COMPUTER-AIDED PROTOTYPING SYSTEM

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The Computer-Aided Prototyping System (CAPS) was created for rapidly prototyping real-time systems to determine early in the software development life cycle whether system requirements can be met. The CAPS consists of several software tools that automatically generate an executable Ada model of the proposed system. This thesis describes the development of a Design Database (DDB) for the CAPS. The DDB is an engineering database that contains all information related to a software design. The DDB enhances the CAPS environment and the prototyping model by providing to the designer the capability to store, retrieve, view and control variation and versioning of the prototype components. This thesis describes the design, test and implementation of a tree structure variation and version control method supporting CAPS.

NPSNET: REAL-TIME 3-D GROUND-BASED VEHICLE DYNAMICS

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The Naval Postgraduate School (NPS) has been developing real-time 3D visual simulators on inexpensive commercially available graphics workstations. The effort to develop a 3D visual simulation system, NPSNET, is an exploration and experimentation virtual worlds. Virtual world system have many goals including military training. This work is part of NPSNET. The current NPSNET system is kinematically based. The objectives of this work are motion dynamics and behavioral motion control for autonomous vehicles. Motion control is difficult when using dynamics due to the internal and external forces, however it enhances the realism as well as motion accuracy. We develop motion dynamics and behavioral control for ground-based vehicles. Motion dynamics and behavioral motion are an essential part of NPSNET for realistic battlefield simulation.

GENETIC ALGORITHMS FOR THE DEVELOPMENT OF REAL-TIME MULTI-HEURISTIC SEARCH STRATEGIES

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Search of an unknown space by a physical agent (such as an autonomous vehicle) is unique in search as the customarily most important goal (to reduce the computation time required to obtain the shortest distance) is not as important as minimal movement. There is a real-time aspect since the agent is actually moving; using energy each step of the way. Having limited energy resources and knowledge of the terrain (only adjacent nodes), the key factor for the physical agent's search algorithm is reduction of steps. Hence, any heuristic that can help keep step count to a minimum must be considered. Korf and Shing addressed this issue in separate works. Both made use of known information about the frontier node's distance from the current node in addition to a heuristic estimating the distance from goal. In this thesis, we present a simple genetics-based method to produce adaptive, efficient multi-heuristic search strategies for the real-time problem. Extensive empirical study shows that this approach produced search strategies with much better performance over existing search algorithms for most terrain types. The methodologies used to develop these improved strategies for our specific case, are also applicable to a multitude of real-time search/optimization problems in the general case.

VISUAL NAVIGATION FOR AN AUTONOMOUS MOBILE VEHICLE

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Image understanding for a mobile robotic vehicle is an important and complex task for ensuring safe navigation and extended autonomous operations. The goal of the work is to implement a working vision-based navigation control mechanism within a known environment onboard the autonomous mobile vehicle *Yamabico-11*. Although installing a working hardware system was not accomplished, the image processing, model description, pattern matching, and positional correction methods have all been implemented and tested on a graphics workstation. A novel approach for straight-edge feature extraction based upon least squares fitting of edge-related pixels is presented and implemented for the image processing task. A simple method for determining the camera's location and orientation (*pose*) follows by matching the vertical extracted edges from an image with the linear features of a two-dimensional view of the modelled environment based upon an estimated pose of the robot. Image processing, construction of the two-dimensional view of the model, and pose determination are conducted sequentially in less than one minute for a 646 x 486 pixel image on 35 MHz processor. The pose determination results have been tested to be accurate to within a few inches for translational error and within one degree rotational error.

USING AN OBJECT-ORIENTED DATABASE MANAGEMENT SYSTEM TO ENHANCE THE REUSABILITY OF CLASS DEFINITIONS

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One of the main benefits of object-orientation is reusability which allows modules (classes/objects) developed for a previous application to be used again for a new application. A Browser in object-oriented systems is a highly specialized system used in class libraries for viewing, writing, and saving code. However, as the number of classes grows from the thousands to the tens of thousands, the Browser approach is not sufficient. The Class Storage and Retrieval System (CSRS) is a proposed system based on the Computer Aided Prototyping System that aims to overcome the insufficiencies of the Browser approach and therefore to enhance the reusability of classes in object-oriented environments.

A TECHNICAL REVIEW OF CELLULAR RADIO AND ANALYSIS OF A POSSIBLE PROTOCOL

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Master of Science in Computer Science-September 1992
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Radio and Television technology made possible the field of computer science. This thesis shows the development of radio and television from both an historical and technical aspect. A review of the important researchers and their contributions is followed by a technical explanation of the theories behind electromagnetic radiation of radio and television signals and the technology which was developed to implement such transmissions. The evolution of development which the paper outlines begins with some of the first theories about electricity and magnetism and the subsequent mathematical foundation developed to explain them. This is followed by a number of experimental and developmental researchers and their contributions. The bulk of the paper is concentrated on explaining the earliest generations of radio and all generations of television. The major components of both radio and television are described in detail along with an explanation of what they do and how they work. Such components, in many cases, found important uses in fields outside those for which they were developed. A brief overview of the regulatory environment of each technology and the U.S. and international standardization efforts is also included. Finally, the paper illustrates a modern-day application of radio technology - the cellular radio industry. A description of the components and their functions is followed by a possible cellular radio protocol and analysis.

GROUP DECISION SUPPORT SYSTEM TO AID THE PROCESS OF DESIGN AND MAINTENANCE OF LARGE SCALE SYSTEMS

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This thesis is a continuation of the research done on the REpresentation and MAintenance of Process knowledge (REMAP) project for large scale systems design and maintenance. A review of the RMAP model and the Cooperative Multiple Criteria Group Decision Making (Co-oP) group decision support system will be conducted. These two models complement each other and their combined functionalities will be examined as they relate to capturing and reasoning with process knowledge. This research further explores possibilities of incorporating group decision support mechanisms into the REMAP model. The analytical techniques suitable for supporting cooperative work in systems design activities, as well as the development of a decision support system incorporating them are evaluated.

A TOOL FOR AUTOMATED VALIDATION OF NETWORK PROTOCOLS

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Master of Science in Computer Science-September 1992
Advisor: G.M. Lundy-Department of Computer Science

This thesis introduces a program that analyzes network protocols using the Communicating Finite State Machines (CFSM) model and the System of Communicating Machines (SCM) model. A simple, two machine implementation of CFSM model is initially explored. A number of simple protocols are demonstrated as a means to validate the automated tool (program). The second model implemented is that of the SCM model. The SCM tool uses many of the same data structures designed in the CFSM program. The SCM program is validated with an analysis of widely used data link protocols. Both programs were done in the Ada language environment.

DETECTING POTENTIAL SYNCHRONIZATION CONSTRAINT DEADLOCKS FROM FORMAL SYSTEM SPECIFICATIONS

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Advisor: Valdis Berzins-Department of Computer Science

This thesis describes a conceptual design for a software tool for automatic detection of synchronization constraint deadlock from the formal specification of a distributed system. The formal specification language Spec is used to define the distributed system. The basic algorithm used is introduced using a graphical representation, and its operation illustrated via an example.

BUILDING REUSABLE SOFTWARE COMPONENTS FOR AUTOMATED RETRIEVAL

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Advisor: Yuh-jeng Lee-Department of Computer Science

The Computer Aided Prototyping System (CAPS) is designed to rapidly build prototypes of real-time systems. A critical element in achieving this goal is a mechanism for automated retrieval of reusable software components from a software base. There were two major objectives of this thesis: (1) to select and prepare software components for inclusion in the CAPS software base; (2) to design and implement a translation tool which takes an Ada specification as input and generates the prototype system description language (PSDL) interface required for storage and retrieval in the CAPS software base - this is necessary since for a component to be usable in the CAPS software base, it must be specified in PSDL. We described the abstraction and implementation of the selected components, introduced the translator, and demonstrated the behaviors of the translator via examples.

A RELATIONAL/OBJECT-ORIENTED DATABASE MANAGEMENT SYSTEM: R/OODBMS

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During the last decade, the business sector has become increasingly reliant upon information management. This trend will most likely continue. Deficiencies/constraints in conventional database management systems continue to become more apparent as this reliance continues to grow. Primary areas of deficiency are in modeling, storing, and managing increasingly complex information as in CAD and CASE among others. The purpose of this thesis is to implement a combined relational/object-oriented database management system that will overcome these deficiencies/constraints. Three possible approaches to such a system a system exist: build the system from scratch, build object-oriented capabilities on top of an existing relational system, or build relational capabilities on top of an existing object-oriented system. The last approach is the one chosen for this work. This thesis expands previous work in this area and uses a commercial object-oriented database management system, IDB, in its implementation.

MODELLING, VISIBILITY TESTING, AND PROJECTION OF AN ORTHOGONAL THREE DIMENSIONAL WORLD IN SUPPORT OF A SINGLE CAMERA VISION SYSTEM

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Advisor: Yutaka Kanayama-Department of Computer Science

Proper interpretation of the environment is essential for mission planning and navigation of an autonomous mobile robot. An on board vision system may provide the most useful raw data. This work develops part of a vision system for the Naval Postgraduate School's mobile robot, Yamabico-11. Accurately modeling the robot's environment is imperative to support position verification and path planning. The decision to use an extended two dimensional model, an orthogonal wire-frame representation, is discussed. Additionally, to support pattern matching, a package of graphic routines, utilizing traditional algorithms and an innovative sweep algorithm (to determine line segment visibility), has been developed. This work demonstrates that an asymmetric model is appropriate to represent a three dimensional environment in support of vision interpretation for mobile robots.

MOTION PLANNING FOR RIGID BODY ROBOTS

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Given a non-holonomic disc robot D, its motion constraints in terms of maximum curvature (k_{max}) and rate of change of curvature (k_{max}), a set W of rectilinear polygonal obstacles which assemble an office-like environment, and two configurations S and G in *free*(W), this thesis investigates the planning of a smooth free path which satisfies the following condition: D is allowed backing up motions at the end portions of the path, but the middle portion is to be of Class C^2 in its entirety. Although the motion planning problem of D amidst polygonal obstacles has been extensively studied, the paths considered are mostly class C^1 and piecewise C^2 only, and are subject only to the k_{max} constraint. Typically, such paths consist of straight line segments and circular ars which have curvature discontinuity at the junction points. In order for D to follow such paths physically, D has to stop abruptly at each junction point to change curvature. The C^2 path investigated in this thesis allows non-stopping motion of D. It is also subject to a further k_{max} constraint to avoid turns that exceed the rate of change of curvature constraint. A class of smooth curves called cubic spirals are adopted for planning C^2 paths. Properties of the cubic spiral are examined in detail. A framework of layered motion planning approach is proposed to divide and conquer the motion planning problem. A novel sensor-oriented method is presented. It plans a spine net which facilitates D carry out deviation correction using sonar sensors while following a motion path.

A STUDY ON THE EFFECTIVENESS OF LOCKUP-FREE CACHES FOR A REDUCED INSTRUCTION SET COMPUTER (RISC) PROCESSOR

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This thesis presents a simulation and analysis of a Reduced Instruction Set Architecture (RISC), and the effects on RISC performance of a lockup-free cache interface. RISC architectures achieve high performance by having a small, but sufficient, instruction set with most instructions executing in one clock cycle. Current RISC performance range from 1.5 to 2.0 CPI. The goal of RISC is to attain a CPI of 1.0. The major hinderance to achieving that goal is attributed to instructions that require main memory access. In this thesis, we attempt to reduce the effects of high penalties for non-cache accesses by using a non-blocking cache memory subsystem called a lockup-free cache. This interface between the cache and main memory prevents the processor from "locking-up" when a request from main memory occurs. This is accomplished by entering all non-cache requests into a memory queue, while the processor continues to issue and execute other instructions. The evaluation of the effects of the lockup-free cache is done using different variations of the interface design. The results from the simulations show that using a lockup-free cache improves RISC performance.

PRIVATE AND SHARED DATA IN OBJECT-ORIENTED PROGRAMMING

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In a typical object-oriented system, we have variables which are private to instances(objects) and variables which are shared by all instances of a class. We may or may not have variables which are shared by multiple classes. Variables may also be declared in some object-oriented languages as private, public, or subtype visible which affects the access to the data. However we know of no object-oriented programming which allows data(variables) to be declared as private for specific methods only. Object-oriented programming is rapidly becoming a popular approach to the construction of complex software systems. Benefits of object-orientation include support for modular design, code sharing and extensibility. The focus of this thesis is to find a solution to the problems of implementing and maintaining both shared and private data in an object-oriented environment.

MULTIMEDIA: THE CASE WITH THE ARMY'S SINGLE EXERCISE ANALYSIS SYSTEM PROTOTYPE

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Advisor: Tung X. Bui-Department of Administrative Sciences

This thesis designs and implements a multimedia prototype of the Single Analysis Exercise System (SEA) for the Army TRADOC Command, Monterey, California. SEAS is intended to assist an Army analyst in constructing an exercise scenario for a battle simulator, Janus(A). The purpose of the multimedia prototype is to provide the user with an integrated digital platform for battle analysis and scenario generation. The immediate benefits of this study will be a significant reduction in the time required to generate a scenario for Janus(A) and will allow the analyst to complete analysis at one workstation. Also, it is expected that the prototype will enhance the quality of the scenario generation process.

NPSNET: JANUS-3D
PROVIDING THREE-DIMENSIONAL DISPLAYS FOR A TRADITIONAL COMBAT MODEL

Jon Curtis Walter-Captain, United States Army
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Master of Science in Computer Science-September 1992
and
Patrick Theron Warren-Captain, United States Army
B.S., Engineering, United States Military Academy, 1982
Master of Science in Computer Science-September 1992
Advisor: Michael J. Zyda-Department of Computer Science

This work involves integrating the Army's existing combat modeling tool, JANUS, with the real-time three-dimensional graphics display offered by NPSNET. The development of a portable software package that can create a three-dimensional virtual world from any exiting JANUS terrain database is explained. In addition, a scripting tool capable of rendering JANUS scenarios previously executed in the traditional two-dimensional model is discussed. This replay capability allows the gamer/analyst the ability to watch the three-dimensional battle unfold from any position on the battlefield. Lastly, the implementation of a real-time, networked link from the two-dimensional JANUS model to NPSNET is detailed. This link involves an Ethernet connection from a Sun workstation, which houses the two-dimensional model, to a Silicon Graphics workstation used for rendering the real-time three-dimensional simulation. The methodology used and techniques developed are fully portable to any workstation with X-windows capability and any graphics workstation equipped with the GL libraries.

NPSNET: DYNAMIC TERRAIN AND CULTURE FEATURE DEPICTION

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The terrain of a battlefield is in a constant state of change. There are new berms and emplacements being built, and bombs are falling leaving a crater marked terrain behind. There are bridges that must be crossed and bridges that may not be crossable. Dynamic terrain is currently not implemented in virtual battlefield simulators such as SIMNET and NPSNET, and as a result there is a lack of needed realism to the battlefield. This work adds the dynamic features: berms, craters and bridges into NPSNET and increases the realism of the simulator dramatically. Vehicles in the simulation realistically traverse the features, tilting and rolling as they should on bumpy terrain. This work was accomplished using C++ and object-oriented programming, adding tremendous flexibility and growth potential to the new terrain and its features, as well as easier maintenance for later users.

NPSNET: JANUS 3-D
PROVIDING THREE-DIMENSIONAL DISPLAYS FOR A TRADITIONAL COMBAT MODEL

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and
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Advisor: Michael J. Zyda-Department of Computer Science

This work involves integrating the Army's existing combat modeling tool, JANUS, with the real-time three-dimensional graphics display offered by NPSNET. The development of portable software package that can create a three-dimensional virtual world from any existing JANUS terrain database is explained. In addition, a scripting tool capable of rendering JANUS scenarios previously executed in the traditional two-dimensional model is discussed. This replay capability allows the gamer/analyst the ability to watch the three-dimensional battle unfold from any position on the battlefield. Lastly, the implementation of a real-time, networked link from the two-dimensional JANUS model to NPSNET is detailed. This link involves an Ethernet connection from a Sun workstation, which houses the two-dimensional model, to a Silicon Graphics workstation used for rendering the real-time three-dimensional simulation. The methodology used and techniques developed are fully portable to any workstation with X-windows capability and any graphics workstation equipped with the GL libraries.

AN AUTOMATED RECONNAISSANCE AND SURVEILLANCE PLANNING TOOL

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Advisor: Michael J. Zyda-Department of Computer Science

The Automated Reconnaissance and Surveillance (R&S) Planning Tool is a prototype of the Army's proposed Common Ground Station, and serves as a Intelligence interface to NPSNET. This system incorporates Intelligence Preparation of the Battlefield (IPB) and intelligence asset modeling in order to create realistic intelligence collection. IPB is the analysis of the affects of the terrain, weather, and enemy doctrine on the friendly situation. Intelligence System Modeling is performed for Mounted and Dismounted Scouts, Ground Surveillance Radars (GSR), Joint Surveillance and Attack Radar System (JSTARS), and Remotely Piloted Vehicles (RPV). These systems collection effort can be monitored by displaying their individual perspectives of the battlefield, or their combined collection effort can be plotted on a 2D or 3D representation of the Terrain. The raw intelligence data produced by these systems is analyzed according to the number and types of enemy vehicles located. Probable enemy courses of action is also generated. Automated R&S planning can greatly enhance the already lethal capability of the Army by speeding up the Collection and Dissemination Process.

DESIGN AND IMPLEMENTATION OF A DATA MODEL FOR THE NPS ARGOS PROJECT

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Advisor: C. Thomas Wu-Department of Computer Science

The ARGOS project is a design and an implementation of a prototype multimedia database system developed as both a Battle Group Commander's assessment tool and a shipboard data management tool. The original prototype was developed using the HyperCard/Macintosh technology, taking advantage of its object-oriented properties and its user-friendly graphical interface. The major problem with the current implementation is that all information is located in a relatively slow and inefficient database. Updates of information have to be hard-coded and access to other databases in or outside the current working environment is not supported. This thesis proposes an enhanced system taking advantage of relational database management technique. The proposed system is based on the idea that all information, including images, button locations, and other system variables, shall be accessed from the relational database management system. This approach makes it possible to separate the user interface from the stored data thus providing a platform independent environment. The enhanced system is developed using Oracle as the relational database management system. The user interface is built in Hypercard on the Macintosh. All data retrieval is based on ANSI SQL.

THE TESTING, ANALYSIS, AND CORRECTION OF THE UPDATE OPERATION OF A PARALLEL, MULTI-BACKEND SUPERCOMPUTER

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Master of Science in Computer Science-March 1992
Advisor: David K. Hsiao-Department of Computer Science

The Multi-Backend Database Supercomputer (MBDS) is designed to provide high-performance database management parallely for applications with very large and growing databases. This thesis is a testing, analysis of and correction of the primary database operation UPDATE of MBDS. We provide an overview of the entire MBDS system and then focus on the parallel UPDATE operation in an attempt to discover and correct the deficiencies of the original UPDATE algorithm.

NPSGDL: AN OBJECT-ORIENTED GRAPHICS DESCRIPTION LANGUAGE FOR VIRTUAL WORLD APPLICATION SUPPORT

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Master of Science in Computer Science-September 1992
Advisor: Michael J. Zyda-Department of Computer Science

Many virtual world applications today represent the cutting edge in real-time 3D interactive graphics. Virtual world applications must model many complex, often changing, graphical objects. These graphical objects must be modeled both visually and behaviorly. The performance of most applications of this nature is determined by the graphics processing capabilities of the hardware used. An efficient, application independent method for describing and managing graphical objects is essential for rapid prototyping and development of robust virtual world applications. This thesis presents an efficient, flexible and extensible graphics description system, NPSGDL, used in virtual world development at the Naval Postgraduate School.

MASTER OF SCIENCE
IN
ELECTRICAL ENGINEERING

FEASIBILITY STUDY OF IMPLEMENTING A CODE DIVISION MULTIPLE ACCESS DATA LINK UTILIZING FIBER OPTIC DELAY LINES

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***B.S.*, Savannah State College, 1984**
Master of Science in Electrical Engineering-September 1992
Advisor: John Powers-Department of Electrical and Computer Engineering

This thesis investigated the feasibility of implementing a coded division multiple access (CDMA) data link that employs fiber-optic delay-line signal processing. A two-user unidirectional data link was built and tested. A review was done of the various coding techniques and signals as used in spread spectrum systems. The thesis discusses hardware design and component selection from both an overall system structure to a more detailed component design. Results of the overall design effort show that a CDMA scheme employing fiber optic delay lines provides a viable option for multiple access networks supporting high rates of data transfer. Additionally the lack of network synchronization between transmitter and receiver makes this particular scheme straightforward to implement.

A COMPILE-TIME APPROACH FOR CHAINING AND EXECUTION CONTROL IN THE AN/UYS-2 PARALLEL SIGNAL PROCESSOR

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Master of Science in Electrical Engineering-June 1992
Advisor: Shridhar Shukla-Department of Electrical and Computer Engineering

The AN/UYS-2 represents the U.S. Navy's effort to meet the signal processing demands of the 21st century. It is programmed using the Processing Graph Methodology (PGM), where signal processing applications are represented as graphs and the nodes specify library primitives. Presently the AN/UYS-2 incorporates a First-Come-First-Serve run-time technique to allocate system resources to support large-grain data-flow execution. While this technique results in low run-time overhead, the system throughput degrades rapidly under high system load. To provide uniform output even under high load, a compile-time technique, called Revolving Cylinder (RC) analysis, is developed further to identify optimal chains and restructure the graph. It is shown by simulation that such chaining and restructuring improve the overall system performance.

ELECTRICAL NOISE CONTROL WITH APPLICATIONS TO ELECTRONIC INTELLIGENCE GATHERING AIRCRAFT

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Master of Science in Electrical Engineering-December, 1991
Advisor: W.R. Vincent-Department of Electrical Engineering

A survey of the sources of electrical noise endemic to Electronic Support Measures aircraft are discussed as background. A discussion of the nature of electric current flow is then provided as the theoretical basis for noise control techniques. Background is provided on two means of potentially reducing noise currents: ground system configuration and the concept of the "topological barrier." Experiments were performed validating the topological approach and invalidating any claims of benefit due to ground system configuration. Additional data was evaluated concerning radiated noise between coaxial cables.

DESIGN AND IMPLEMENTATION OF A TOKEN-RING FIBER OPTIC LOCAL AREA NETWORK

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Master of Science in Electrical Engineering-December 1991
Advisor: John P. Powers-Department of Electrical and Computer Engineering

This thesis describes the design and implementation of a fiber optic token-ring local area network (LAN). This design features fiber optic channels between stations on the network without the use of a wiring concentrator. The initial LAN electrical signal operating at 4 Mbps was provided by a LAN adapter card based on the TMS380 chipset developed for twisted pair copper wire. Since the physical characteristics of fiber and wire vary, use of this adapter necessitated that the design be able to deceiver system Successful LAN communications over the fiber optic channels are described.

A COMBINATORIAL APPROACH TO AUTOMATED LOFARGRAM ANALYSIS

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This thesis examines the combination of three algorithms: Graph Theoretic Tracker (GTT), Hough Transform, and Heuristic Search to enhance the detection of spectral tracks of underwater targets in LOFARGRAMS. Previous studies examined these algorithms separately. Here, GTT is used as a pre-processor of the LOFARGRAM display data to locate optimum paths of signals through noise. The line tonals in the output image from GTT are then manipulated by the Hough Transform into clusters of points in parameter space. A Heuristic Search sorting technique is employed to determine cluster centers. These cluster centers are then reconstructed back into line tonals using the inverse Hough Transform formula. The results of this thesis show improvements by taking the Hough Transform of the original LOFARGRAM masked by the output of GTT. The effect of background noise is offset by the accumulation in the parameter space. Subsequently, the recovery of desired tonals is improved.

ANALYSIS OF SIMULATION TOOLS FOR THE STUDY OF ADVANCED MARINE POWER SYSTEMS

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The United States Navy is at a crossroads in the design of ship's engineering plants. Advances in solid-state power electronics combined with a shift to gas turbine powered propulsion and electric plants has placed renewed emphasis on developing advanced power systems. These advanced power systems may combine the prime movers associated with propulsion and electric power generation into an integrated system. The development of advanced electric distribution systems and propulsion derived ships service (PDSS) power systems are interim steps toward the goal of an integrated system. Advances in the design of ships power systems, whether revolutionary or evolutionary, will require extensive testing and simulation. This thesis will develop a basis with which to judge various simulation tools. It will then evaluate a simulation program developed for the Navy by the Massachusetts Institute of Technology.

ANALYSIS OF CONSTANT PHASE CONTOURS OF EVAPORATION DUCT MODE FUNCTIONS FOR WAVEGUIDE MODE PROPAGATION

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The M-Layer program tracks the constant phase line $Im\{D(q)\} = 0$ and looks for their intersections with the lines $Re\{D(q)\} = 0$ for the locations of the zeros of the mode function $D(q)$. These two types of constant phase lines are tracked and plotted over a search region which contains modes having a range attenuation rate of no more than 5 dB per km. Several new parameters for use in mode search are deduced from the results and some old ones are verified. Future studies in waveguide mode propagation theory pertaining to atmospheric ducts may benefit from this work. An improved modesearch strategy is also proposed.

APPLICATIONS OF THE *TOTAL LEAST SQUARES* TECHNIQUE TO FREQUENCY ESTIMATION

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Estimating the frequencies of signals in a noisy environment has numerous applications in digital signal processing. In December 1980, Golub and Van Loan proposed a spectral estimator called the *Total Least Squares (TLS)* technique which is a refinement of the *Least Squares (LS)* technique. In this thesis, we first describe the origin of the *TLS* technique and its applications to frequency estimation. Furthermore, we present a numerical implementation for resolving two damped/undamped closely-spaced sinusoidal signals in white noise. Next, we introduce *TLS* extensions such as the *Constrained Total Least Squares (CTLS)* technique and the *Linear Constraint Total Least Squares (LCTLS)* technique. The *CTLS* addresses the case where the noise components are related and the *LCTLS* addresses the case where one desires to resolve between two narrowband signals close in frequency, one of which is known. Finally, we present a numerical implementation of the *Recursive Total Least Squares (RTLS)* technique and apply it to the case of a signal with a fixed frequency together with a signal with a time-varying frequency.

FERROELECTRIC MEMORY DEVICES AND A PROPOSED STANDARDIZED TEST SYSTEM DESIGN

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Ferroelectric bulk material devices have been in existence for over 20 years. Not until recently has there been fabrication techniques that consistently and feasibly produce thin film ferroelectric materials. The physical characteristics of thin film ferroelectric capacitors and their subsequent integration into memory design may prove ferroelectric devices to be the ultimate in design for non-volatile, radiation hard computer memory. This thesis describes current memory systems, some of the recent achievements in ferroelectrics and the prospects for further application of ferroelectrics as an alternative for current memory design. It explores the different testing methodologies being implemented to test ferroelectric devices and suggests a flexible, fully programmable and autonomous new test system design to allow high speed aging and fatigue testing of on-chip ferroelectric capacitors for memory applications.

DESIGN AND IMPLEMENTATION OF A FIBER OPTIC LINK FOR A TOKEN RING LOCAL AREA NETWORK

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This thesis describes the design and implementation of a fiber optic link for a token ring local area network (LAN). It features the use of fiber optic channels as the transmission medium between a computer system and a wiring concentrator to convert a physical ring design into a starwired configuration. The LAN was controlled by the TMS380 LAN Adapter chipset, which provided all diagnostic and network management features to include the 4 Mb/s electrical signal for operation. Since this adapter was developed for systems using twisted wire pair adapter cables, design modifications required that the fiber link be able to simulate impedance and current characteristics of the copper wire link. This allows the use of adapter diagnostic checks for ring continuity and proper ring operation. Design evaluations using test signals and adapter signals from within the computer-concentrator link showed mixed results. All transmission objectives were met but the circuit loaded down the LAN adapter causing hardware error messages.

MINIMIZATION OF MULTIPLE-VALUED PROGRAMMABLE LOGIC ARRAY USING SIMULATED ANNEALING

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Guaranteed minimal realizations of multi-valued programmable logic arrays can only be accomplished by an exhaustive search. Exhaustive search is not very realistic for complex expressions due to the immense amount of CPU time required to reach a solution. To circumvent this problem, heuristics have been developed. They provide near-minimal solutions, but use substantially less CPU time. This thesis investigates a new type of heuristic which is built on the foundation of simple implicant operations controlled by an annealing process. This new type of heuristic is superior to existing heuristics with respect to minimization capability but requires more CPU time.

ROUNDOFF ALGORITHMS FOR DIGITAL PHASE SHIFTERS THAT MINIMIZE BEAM SHIFT

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The performance of a phased array antenna depends upon the phase and amplitude distribution across the aperture. A continuous linear phase distribution is required for an efficient focused beam, but practical phase shifters are digital devices and can only provide an approximation to a linear phase distribution. Consequently some type of roundoff criteria must be established. The method of roundoff affects the radiation pattern characteristics such as beam location and sidelobe level. Accurate target tracking requires that a radar have a small beam pointing error. Low sidelobes are also desirable to prevent jamming and the illumination of clutter. Therefore the goal was to select a roundoff criterion that provides a phase distribution across the aperture to minimize both the beam shift and the sidelobe levels, while simultaneously maximizing the gain. The methods examined are referred to regular roundoff, weighted random roundoff, running sum roundoff and symmetric running sum roundoff. The first two are in common use, but the third and fourth are new methods examined in this paper. It was demonstrated that the latter two have the minimum beam shift of the four roundoff methods, without significantly degrading the other pattern properties.

ALLOCATION OF PERIODIC TASKS WITH PRECEDENCES ON TRANSPUTER-BASED SYSTEMS

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A scheme for static allocation of periodic tasks with precedences to processors is developed considering task execution times, communication costs, and utilization level of each processor. It has the main goal of minimizing the application response time with a minimum number of processors. A network of transputers is employed as a platform to experimentally evaluate the allocation approach constructed with this work. The first phase of the allocation scheme is a constructive assignment heuristic that generates an initial allocation. The initial allocation is improved in the second phase by using an iterative pairwise interchange of tasks that considers interprocessor communication distances. The overall scheme of task allocation was successfully tested and analyzed through simulation of several applications on a transputer network providing a near optimal solution.

FAST HIGH-RESOLUTION TECHNIQUES APPLIED TO THE DIRECTION OF ARRIVAL (DOA) OF SIGNALS PROBLEM

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Subspace decomposition methods are a very useful technique to extract the signal information via eigen-based estimators. Although those techniques are very accurate, they are usually expensive to update, becoming difficult to implement for real-time applications. The Rank-Revealing QR (RRQR) factorization introduced by Chan, offers an attractive alternative to perform the subspace selection. In this work, we use the RRQR algorithm applied to the Direction of Arrival (DOA) problem to track moving sources, using passive linear arrays. In addition to the regular RRQR algorithm originally proposed by Chan, this thesis introduces an improvement. This refinement uses the signal subspace information and requires very little additional computation. It takes advantage of the Hermitian property of the signal correlation matrix and is implicitly equivalent to applying one subspace iteration step to the estimated signal subspace. Simulations show that the performance obtained is equivalent to that obtained using classical eigen-based techniques. Alternative algorithms for finding an approximation of the smallest singular vector of the correlation matrix are discussed and compared to the original method. The final product is an adaptive algorithm that allows for tracking of DOA angles when moving sources are present. An analysis of the number of flops needed to executive the adaptive algorithm based on the RRQR factorization to track the DOA of moving sources has been included, showing its feasibility for being used in real-time implementation.

A COMPUTER MODEL FOR THE TRANSMISSION CHARACTERISTICS OF DIELECTRIC RADOMES

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The electric far field radiation pattern is determined for a uniformly illuminated, linearly polarized circular aperture transmitting through a dielectric radome located in the near field of the aperture. A modified electric field integral equation using the method of moments procedure and the thin shell approximation for dielectrics. The resulting solution was computer coded for ogive and spherical radome shapes. The program is designed in a modular fashion to accommodate the addition of different antenna types, illumination functions, or radome shapes.

DEVELOPMENT OF A MATLAB TOOLBOX FOR IMAGE PROCESSING

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This thesis provides an Image Processing Toolbox for use with MATLAB which contains ready-made tools for students and faculty who wish to continue research in image processing and related areas. The Toolbox is available for several computer environments. The documentation provided with the distribution diskette contains both a tutorial and reference section in the MATLAB style. This thesis report provides information needed to write and compile C language programs for use as MEX-files, an overview of the Toolbox, and a case study which illustrates the use of some of the functions in the Toolbox.

COMPUTER ANALYSIS OF HARMONIC DISTORTION IN ELECTRICAL POWER DISTRIBUTION SYSTEMS

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The number of nonlinear loads connected to power distribution systems is rapidly increasing. These loads disturb the sinusoidal nature of the power distribution systems to which they are connected. Consequently, all connected loads may be affected by even a single nonlinear load. This makes power quality an increasingly important issue, particularly in shipboard applications because equipment malfunction can cause the loss of life. This study primarily develops a modeling technique for use with the harmonic power flow program (*HARMFLO*) developed by the Electric Power Research Institute. A land-based power distribution system is modeled and simulation results are compared to field measurements. Additionally, the causes and effects of harmonic disturbances in power distribution systems are reviewed. In spite of the fact that many parameters of the system being modeled are not precisely known, simulation results are similar to the field measurements. This implies that *HARMFLO* has applications in isolating existing harmonic disturbances of installed systems and impact assessment for planned systems with one or more nonlinear loads.

EXTENDED SURFACE HEAT SINKS FOR ELECTRONIC COMPONENTS: A COMPUTER OPTIMIZATION

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Heat sinks consisting of individual fins and arrays of fins are used extensively throughout the Navy and industry. The fins serve to increase the surface area through which heat is transferred to the surrounding environment by natural convection. Extended surfaces or fins are commonly found on electronic components ranging from power supplies to transformers. The dissipation and subsequent rejection of potentially destructive self-produced heat is an important aspect of electronic equipment design. Fin design theory is examined starting with the optimization of individual fin dimensions. The insights obtained are utilized in an investigation of the optimal number and spacing of elements in an array of fins. The results are implemented in a computer program written in ADA and compiled for use on IBM compatible machines. The program takes as inputs thermal and physical data and outputs an optimized fin configuration. Menu driven, the program is easily employed without any amplifying documentation. The program serves to greatly simplify and accelerate the fin design process and should be an invaluable tool to electronic component designers, especially those with a limited background in heat transfer and fin optimization theory.

A MICROPROCESSOR INTERFACE FOR THE NM24CF04 SERIAL-ACCESS FERROELECTRIC MEMORY

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The goal of this study was to demonstrate the feasibility of utilizing ferroelectric memory as a portion of main microprocessor memory. An interface between National Semiconductor's NM24CF04, a nonvolatile, serial-access, ferroelectric memory device, and Intel's 8086 microprocessor was designed and implemented. This thesis discusses the architectural and implementation problems that arise when installing this ferroelectric memory device as a portion of main memory. The actions of the interface are detailed to explain the control and timing requirements necessary to effectively perform write and read operations on the NM24CF04.

COMPUTER MODELING OF TACTICAL HIGH FREQUENCY ANTENNAS

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The purpose of this thesis was to compare the performance of three tactical high frequency (HF) antennas to be used as possible replacement for the antenna system of the Tactical Data Communications Central (TDCC) by modeling the antennas using computer codes. The Numerical Electromagnetics Code, Version 3.0, and the Eyring Low Profile and Buried Antenna Modeling Program (PAT7) were used for several different frequencies and ground conditions. The performance was evaluated by comparing gain at the desired takeoff angles, the voltage standing wave ratio (VSWR) of each antenna and its omni-directional capability. The buried antenna models, the ELPA-302 and horizontal dipole, were most effective when employed over poor ground conditions. The best performance under all conditions tested was demonstrated by the HT-20T. However, each of these antennas have tactical advantages and disadvantages and can optimize communications under certain conditions. The selection of the best antenna for the mission is dependent upon operational or specific mission requirements. An experimental test of these models is recommended to verify the modeling results.

INSTANTANEOUS POWER SPECTRUM AND 1 1/2D INSTANTANEOUS POWER SPECTRUM TECHNIQUES

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The IPS (Instantaneous Power Spectrum) spectral analysis technique has been the subject of study for many years. This thesis implemented the IPS algorithm using MATLAB. In addition, two additional programs were written to deal with progressively larger data sets. Based on a third order cumulant, the 1 1/2D spectral analysis technique, thought to perform well in low signal to noise environments, is also explored.

REVISING M-LAYER: COMPLEX EXPONENT REPRESENTATION

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The waveguide mode tropospheric propagation effect prediction program, M-Layer, originally written by Naval Command Control and Ocean Surveillance Center, Research, Development, Test and Engineering Division (NRaD), is revised for greater accuracy, speed and stability. The accuracy improvement is achieved first by converting the extended complex number representation into the representation by the complex exponent then by re-writing the group of Airy function computation subroutines. This accuracy improvement makes it possible to implement a self-checking procedure for determining the proper method to evaluate the height gain function. Finally, a new mode locating algorithm is introduced which improves the efficiency of mode search and eliminates the looping problem observed. The revision has been documented and the new program source code has been delivered to NRaD. It is also recommended that the mode search protocol, not just the mode locating algorithm introduced in this revision, be completely revised for better performance.

IMAGE PROCESSING WITH THE NAVAL POSTGRADUATE SCHOOL INFRARED SEARCH AND TARGET DESIGNATION SYSTEM

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An analysis of infrared background scenes generated by the Naval Postgraduate School Infrared Search and Target Designation (NPS-IRSTD) System, and captured with a DT-2861 frame grabber board, was conducted using a FORTRAN program developed to facilitate image enhancement, clutter suppression and visual target discrimination. The developed FORTRAN program, incorporating the X-arRAY subroutine library to provide access to the DT-2861 memory buffers in the 80386 extended memory, provides access to pre-defined spatial frequency filters for image processing. The program was used to process image data obtained concurrently with the NPS-IRSTD and an AGA 780 Thermovision system operating in the same (3-5μm) waveband. Image histograms and qualitative features of the two image types have been compared. Application of image enhancement and edge detection filters to IRSTD scenes with and without background clutter is considered. Visual target enhancement is observed, together with additional generation of image noise.

ADAPTIVE NOISE CANCELLATION APPLIED TO THE NUWES TEST RANGES

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This thesis investigates the application of adaptive filtering at the NUWES test ranges. Two adaptive algorithms, least-mean-squares and recursive-least-squares are studied. To facilitate the investigation, a model of the test ranges was developed. This model accounts for spherical spreading and linear attenuation of the propagated acoustic signals as well as the effects of doppler shift, multipath, and finite propagation delay time. After describing the model, the adaptive filtering algorithms are briefly explained. The two schemes of adaptive filtering, adaptive noise cancellation and adaptive line enhancement, are applied to the model. Simulation results of the noise cancellation and line enhancement schemes are presented for several scenarios.

IMPLEMENTATION OF FUZZY INFERENCE SYSTEMS USING NEURAL NETWORK TECHNIQUES

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Fuzzy inference systems work well in many control applications. One drawback, however, is determining membership functions and inference control rules required to implement the system, which are usually supplied by 'experts'. One alternative is to use a neural network-type architecture to implement the fuzzy inference system, and neural network-type training techniques to 'learn' the control parameters needed by the fuzzy inference system. By using a generalized version of a neural network, the rules of the fuzzy inference system can be learned without the assistance of experts.

IMPLEMENTATION OF THE ONE-BIT SPECTRAL CORRELATION ALGORITHM

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The computational efficiency of the *One Bit Spectral Correlation Algorithm* is compared to other cyclic spectrum analysis algorithms. A transmission bandwidth advantage is discussed. A parallel computational structure which implements the OBSCA is described and a system architecture is proposed.

COHERENT/NONCOHERENT DETECTION OF COHERENT OPTICAL HETERODYNE DPSK-CDMA AND MFSK-CDMA SIGNALS

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The system performance of a coherent optical heterodyne communication system is analyzed for MFSK-CDMA and DPSK-CDMA signalling. The analysis determines the effect that receiver thermal noise, photodetector shot noise, laser phase noise, and multiple user noise has on the system performance. For the single user system performance, the probability of bit error of the system as a function of E_b/N_o is calculated for laser linewidth-to-bit rate ratios from 0.1 to 0.01. For both MFSK and DPSK, the system performance is most affected by laser phase noise at higher linewidth-to-bit rate ratios. The multiple user analysis for MFSK-CDMA and DPSK-CDMA is determined by calculating the probability of bit error as a function of the number of users for various laser linewidth-to-bit rate ratios and codelengths. The observations made for the single user case concerning the effects of laser phase noise on system performance are also observed for the multiple user case. When the effects of the laser phase noise no longer dominate system performance, then MFSK-CDMA and DPSK-CDMA can be used to increase the user capacity of optical fiber systems.

WAVELET-BASED MULTIRESOLUTION ANALYSES OF SIGNALS

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Signal analysts have traditionally relied on the Discrete Fourier Transform and various data windowing schemes for signal detection and classification. Some signals, notably those of a transient nature, are inherently difficult to analyze with these traditional tools. The Discrete Wavelet Transform has recently generated considerable interest in several areas of digital signal processing and a determination of its suitability as a signal analysis tool is necessary. Associated with wavelet theory is the concept of multiresolutional analyses which allow examination of a signal at different scales. This thesis investigates dyadic discrete wavelet decompositions of signals. A new multiphase wavelet transform is proposed and investigated. The multiphase transform technique is shown to be useful in transient signal analysis. Several MATLAB™ programs that perform multiresolutional analyses with various supporting features are provided.

FAST REACTION MISSILE CONTROL FOR POINT DEFENSE

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Optimal Control Theory is revisited. A minimum time control rule for a third order regulator is found. A third order missile model is developed. Minimum time control is applied to the fast reaction missile defense problem. The results are compared with Proportional Navigation. The states controlled in the minimum time application are the derivatives of Line-of-Sight angle and the vertical distance and derivatives between missile and the target.

THE PREDICTION OF THE PERFORMANCE OF A MICROCIRCUIT HEAT SINK IN THE BOILING MODE

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As microcircuit technology advances, there is an increased need for the dissipation of the heat which is generated. Extended surfaces are a useful tool in fulfilling the heat sink requirements for a microcircuit element. Heat transfer is very effective in the boiling mode and this thesis focuses on the analysis of a spine-shaped extended surface in a boiling liquid. Because the heat transfer in the spine and the propagation of signals on a transmission line are governed by identical differential equations, an analysis procedure based on the cascading of electrical transmission lines is used to predict the performance of the spine. The result of the analysis is a computer program that can assist the circuit designer in meeting any heat transfer requirements.

DESIGN AND EVALUATION OF PORTABLE ANTENNAS FOR LOCATION OF SOURCES OF RADIO NOISE EMANATING FROM POWER-LINE HARDWARE

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Power-line noise (PLN) is a major contribution to factors which cause the loss of signals at naval receiving sites. Navy Signal-to-Noise Enhancement Program (SNEP) teams have developed portable instrumentation for the location of RF noise-producing power-line hardware. An important component of this instrumentation is a lightweight antenna with modest directivity and wide bandwidth (60-800 MHz). The purpose of this study is the design, construction, analysis and measurement of three customized Log-Periodic Dipole Arrays (LPDA) for use in locating PLN sources. Modifications to standard LPDA designs include a feeder boom with convenient construction features and emphasis on a compact, lightweight, portable structure. The Numerical Electromagnetics Code (NEC) was used to analyze the performance of the various designs. Input impedances were measured in operational environments using network analyzers. The final designs were field-tested at a U.S. Naval site in Okinawa and found to be completely acceptable for SNEP use.

ONE- AND TWO-DIMENSIONAL DISCRETE WAVELET TRANSFORMS

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Fourier transform techniques have been the favored methods in the analysis of signals and systems. One major drawback of Fourier methods is the difficulty in analyzing transient and/or non-stationary behavior. Recent advances in the field of wavelet theory show much promise in alleviating these problems. This thesis considers the realizations of the wavelet decomposition and reconstruction algorithms for the discrete case. The major discussion will involve both the one and two dimensional transforms. We also present a multiple-phase development as a second and possibly a preferable method for decomposing signals.

FUNCTION ALLOCATION IN A ROBUST DISTRIBUTED REAL-TIME ENVIRONMENT

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Critical real-time computing systems are characterized by a stringent set of reliability and performance requirements. Distributed systems, often defined to encompass a broad class of loosely coupled computer systems, are an effective means of achieving reliability and increasing system throughput. Among the many desirable characteristics that can be achieved at the application level using such a system are dynamic response to changing processing loads of functions (tasks) and exploitation of inherent parallelism using distribution. In these systems, functions must be assigned and scheduled in an attempt to be completed prior to their deadlines. Initial assignment of functions to processors (nodes) must not preclude their subsequent dynamic reassignment/reconfiguration in response to load changes or failure/repair. These allocation and reconfiguration methodologies are as diverse as their applications. A technique to manage the complexity of building such a system is a layered architecture with reconfiguration accomplished by an individual layer of software. This thesis investigates allocation and reconfiguration algorithms. The proposed scheme for initial allocation is based on load balancing utilizing estimated execution times of the functions. The approach with respect to reconfiguration, simulated using concurrent Ada processing for a four node distributed system, is based on globally ordered broadcast communications between functions of the application program.

A TECHNIQUE FOR PREDICTABLE REAL-TIME EXECUTION IN THE AN/UYS-2 PARALLEL SIGNAL PROCESSING ARCHITECTURE

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The AN/UYS-2 provides the Navy with a state of the art Digital Signal Processor. The AN/UYS-2 is programmed utilizing the Processing Graph Methodology (PGM), which represents specific tasks as nodes in a graph. It utilizes a simple First-Come-First-Served (FCFS) run-time resource allocation mechanism that supports large-grain data flow processing. While the mechanism is robust, easy to implement, and results in low run-time overhead, it is difficult to predict if a given PGM will meet the application requirements. Therefore, an approach that uses compile-time analysis to exploit the periodic arrival of data and a priori knowledge of the amount of computation and communication overhead is investigated. Improvement in performance of the machine when the PGM graphs are restructured using this approach, called Revolving Cylinder scheduling, is observed; and it is found to be effective when there is a high communication overhead or when the PGM nodes are of uniform size.

REAL-TIME SCHEDULING AND SYNCHRONIZATION FOR THE NPS AUTONOMOUS UNDERWATER VEHICLE

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The work described in this thesis is part of a multi-year research project to develop an Autonomous Underwater Vehicle (AUV-II), which is an intelligent robot submarine, carried out by the departments of Mechanical Engineering, Computer Science, and Electrical and Computer Engineering of the Naval Postgraduate School. The AUV-II on-board computer must perform several different tasks such as navigation, autopilot, guidance, sonar processing, and collision avoidance, etc. under strict timing constraints to guarantee the safety of the vehicle. This thesis describes the design and development of real-time scheduling software, which is capable of scheduling and synchronizing the periodic and aperiodic processes required by the AUV-II. A design recommendation of a Graphical User Interface has been developed to improve the software engineering aspects of this project.

COMPUTERIZED DIAGNOSTIC ANALYZER FOR SSBN 726 CLASS LOW VOLTAGE DC WEAPON POWER SYSTEM

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A need exists for a new test procedure for the Low Voltage DC (LVDC) Weapons Power System used to provide 28 volt DC power to various portions of the Fleet Ballistic Missile (FBM) Weapons System found on Ohio Class Submarines. The present test procedure does not provide sufficient information to assure that the system will function with the required reliability. This project involved the design and implementation of a test system which would perform the following functions: 1) accurately monitor the performance of the 28 volt LVDC rectifiers in the FBM Weapons System, 2) indicate when a system failure has occurred, 3) provide information to assist in trouble shooting, 4) provide facilities for database storage and analysis. This system is portable, user friendly, and compatible with current test requirements.

ACTIVE DAMPING OF VIBRATIONS ON SPACE STATION FREEDOM USING LINEAR QUADRATIC GAUSSIAN CONTROL AND H∞ CONTROL

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Active damping of modal oscillation is critical to the success of future versions of Space Station Freedom. Vibratory motion may be induced by external disturbances such as solar and gravity gradient torques, extra vehicular and experimental activity, aerodynamic forces, the earth's magnetic field, and space shuttle docking. Linear proof mass actuators can provide control on the space station to achieve this damping effect. Two control algorithms, Linear Quadratic Gaussian control and H∞ control are applied to a model of Space Station Freedom. The results compare the robustness, stability, and performance of the Space Station under the effects of each of the two control algorithms.

ADAPTIVE FILTER DESIGN USING DISCRETE ORTHOGONAL FUNCTIONS

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Master of Science in Electrical Engineering-March 1992
Advisor: Murali Tummala-Department of Electrical and Computer Engineering

Discrete orthogonal functions are used in adaptive system identification algorithms. Adaptive filters are realized by forming linear combinations of discrete Legendre, Laguerre, and Jacobi polynomials, and backward prediction-error polynomials from a lattice structure. The adaptive filter weights are updated using the LMS algorithm. FIR and IIR bandpass filters are modeled using the adaptive filters, and performance comparisons are made.

NONLINEAR ADAPTIVE CONTROL USING BACKPROPAGATING NEURAL NETWORKS

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The objective of this research is to develop a nonlinear regulator for an adaptive control system using backpropagating neural networks (BNN's) in conjunction with a linear quadratic regulator (LQR). The basic concepts of adaptive control and the structure of neural networks are discussed. These concepts are integrated and the nonlinear regulator is derived. Simulation is conducted on a representative nonlinear system with both the LQR and the nonlinear regulator. Training of the regulator and its performance under varying BNN parameter values are examined. The simulation results show that the nonlinear regulator with BNN's exhibits superior performance compared to the LQR when the nonlinearities are large. The optimization of regulator performance with regard to BNN parameter values is discussed. Further research is required in order to determine the general applicability of this regulator and to develop more specific guidelines for BNN parameters.

AN APPLICATION OF EXTENDED KALMAN FILTERING TO A MODEL-BASED, SHORT-RANGE NAVIGATOR FOR AN AUV

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Autonomous Underwater Vehicles (AUV) are being considered by the Navy for performing a variety of missions. During the research and development stage of the AUV project at the Naval Postgraduate School, a navigator is needed to provide vehicle position estimates for short-range missions performed in a test pool environment. This navigator should operate with inexpensive sensors and not require excessive digital processor time. This thesis presents the results of the design of a model-based navigator. The navigator uses nonlinear vehicle models and Extended Kalman filter theory. Simulation studies for both a 12,000 pound vehicle and the 435 pound testbed vehicle, designed and built at the School (NPS AUV II), are presented. Results of using data recorded from the gyroscopes and depth cell installed in the NPS AUV II vehicle in lieu of simulated data are also discussed. These results show that the navigator meets the goals of low cost and low processor burden for short-range missions.

A CIRCUIT MODEL FOR TWO-PATH CUTOFF WAVEGUIDE DIELECTRIC RESONATOR FILTERS

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This thesis describes the development of a CAD circuit model for two-path cutoff waveguide dielectric resonator filters. The model was verified using published data of known designs in X-band waveguide. Results of model simulation agree very well with experimental data. Also, a method for designing this type of filter is proposed. It makes use of commercially available CAD software. An example of the design procedure is given, along with experimental data obtained from a filter manufactured according to the design.

DESIGN OF ROBUST SUBOPTIMAL CONTROLLERS FOR A GENERALIZED QUADRATIC CRITERION

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Standard linear quadratic regulator (LQR) designs guarantee a certain level of robustness. However, optimizing a generalized quadratic criterion produces coupled state and input terms and there are no longer any guarantees of good robustness properties. This thesis identifies how this problem arises and then presents several suboptimal, but robust controller design options which provide the control systems engineer with the ability to perform a trade-off between performance and robustness. The effectiveness of these methods is investigated and the trade-offs between performance and robustness are evaluated using computer simulation of a statically unstable fighter aircraft.

USE OF MINIMUM TIME CONTROLLERS IN VERTICALLY-LAUNCHED SURFACE-TO-AIR MISSILES

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This thesis develops the concept of minimum-time (Bang-Bang) controllers and their application to missile control. Based on Pontryagin's minimum principle, a minimum-time second order controller is derived. This controller is then applied to control of a vertically-launched surface-to-air missile. In the boost phase of missile flight, the minimum-time controller drives the missile body axis from vertical to a commanded angle in minimum time. In the terminal phase of the missile-target engagement, the minimum-time controller drives the time rate of change of the line of sight angle to zero in minimum time. The results obtained with the minimum time controller are compared with those obtained with the Proportional Navigation control algorithm, which is commonly used in tactical surface-to-air and air-to-air missile.

CORRECTION OF INERTIAL MEASUREMENTS USING GPS UPDATES FOR UNDERWATER NAVIGATION

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An Autonomous Underwater Vehicle (AUV) can combine a Global Positioning System (GPS) receiver with an Inertial Navigation System (INS) to navigate with a specified accuracy level. The AUV would be required to surface periodically to obtain a GPS fix. A computer simulation has been developed using an AUV model and an INS error model to generate noisy measurements. A Kalman filter is used to estimate the simulated INS errors. Several runs were executed to compare combinations of equipment with different levels of accuracy.

PUBLIC-KEY CRYPTOGRAPHY: A HARDWARE IMPLEMENTATION AND NOVEL NEURAL NETWORK-BASED APPROACH

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The concealment of information passed over a non-secure communication link lies in the complex field of cryptography. Furthermore, when absolutely no secure channel exists for the exchange of a secret key with which data is encrypted and decrypted, the remedy lies in a branch of cryptography known as public-key cryptosystem (PKS). This thesis provides an in-depth study of the public-key cryptosystem. Essential background knowledge is covered leading up to a VLSI implementation of a fast modulo exponentiator based on the sum of residues (SOR) method. Fast modulo exponentiation is vital in the most popular PKS schemes. Furthermore, since all cryptosystems make use of some form of mapping functions, a neural network - an excellent non-linear mapping technique - provides a viable medium upon which a possible cryptosystem can be based. In examining this possibility, this thesis presents an adaptation of the back-propagation neural network to a "pseudo" public-key arrangement. Following examinations of the network, a key management system is then devised. Finally, a complete top-down block diagram of an entire cryptosystem based on the neural network of this study is proposed.

METHOD OF MOMENTS ANALYSIS OF SYMMETRIC DUAL REFLECTOR ANTENNAS WITH FEEDS

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Small symmetric dual reflector antennas have low efficiencies because of conflicting requirements for the subreflector and feed. Low efficiency is more pronounced for antenna configurations with main reflector diameters less than 50 times its operating wavelength. The subreflector and feed geometry must be small to reduce blockage but yet large enough to be an efficient scatterer. It may be possible to compensate for this by tuning the feed and subreflector. That is, by proper choice of the antenna geometry and dimensions and by using low-blockage feeds, the efficiency may be enhanced. Existing computer codes have been modified in this thesis to reflect these changes in antenna feeds in order to optimize the antenna efficiency. A feed system consisting of a fed dipole in the presence of parasitic elements has resulted in an efficiency of 55%. Other untested feed configurations may produce even higher efficiencies.

FIXED AND DATA ADAPTIVE KERNELS IN COHEN'S CLASS OF TIME-FREQUENCY DISTRIBUTIONS

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Estimating the spectra of non-stationary signals represents a difficult challenge. Classical techniques employing the Fourier transform and local stationarity have been employed with limited success. A more promising approach is the use of time-frequency distributions. The majority of useful distributions have been unified under Cohen's class of distributions, a bilinear transformation with an arbitrary, fixed kernel function. The properties of several popular distributions developed from Cohen's class of distribution are examined. The ability of the kernel to suppress spurious cross-terms resulting from the bilinear nature of these distributions is examined along with their characteristics. Distributions employing a fixed kernel usually give good results only for a small class of signals. A data adaptive kernel is also examined which promises to give superior results for a broad class of signals. Results are shown for several test cases employing synthetic, analytic signals.

RECONFIGURATION IN ROBUST DISTRIBUTED REAL-TIME SYSTEMS BASED ON GLOBAL CHECKPOINTS

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Fast, ultra-reliable, real-time computing is fundamental in today's weapons system. Increased system throughput and reliability can be achieved by utilizing distributed systems in which a single application program executes on multiple processors, connected to a network. The distributed nature of such systems make it possible to tolerate failures and react to overloads without the application level performance degrading unacceptably. Fault tolerance in these systems typically involves fault detection and recovery. Repair following failure involves smooth integration of the repaired processor and subsequent reconfiguration. These actions must take place transparently, that is without the application program noticing it. Therefore, sufficient information must be maintained through the use of checkpointing to describe the state of the system at any time and ensure correct operation after failure/repair. This thesis investigates a possible framework for achieving a fault-tolerant real-time distributed system which provides transparent function-to-function message passing, status monitoring using periodic health messages and maintains a globally consistent system state by carrying out independent checkpointing procedures. The proposed scheme is simulated using concurrent Ada processing for a four node, twelve function, distributed system.

DEVELOPMENT OF AN NPS MIDDLE ULTRAVIOLET SPECTROGRAPH (MUSTANG) ELECTRONIC INTERFACE PACKAGE

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Master of Science in Electrical Engineering-December 1991
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This thesis developed a robust electronic interface package for the Naval Postgraduate School (NPS) Middle Ultraviolet Spectrograph (MUSTANG) experiment. The MUSTANG instrument was designed to observe atmospheric emissions in the 1800Å to 3400Å wavelength region. MUSTANG has flown along with a Naval Research Laboratory (NRL) instrument on a NASA sounding rocket experiment, and is scheduled to fly on two more sounding rockets prior to integration on an Air Force satellite. Data from these experiments will test a new technique for measuring global ionospheric electron densities on a real-time basis. The electronic interface links the MUSTANG instrument with the Aydin Vector MMP-600 Series Pulse Code Modulation Encoder in the sounding rocket telemetry section. Analog data from MUSTANG is digitized and buffered in the electronic interface to support asynchronous transfer to telemetry. Digitized MUSTANG data is telemetered to a ground station during rocket flight. This electronic interface circuit was thoroughly tested during payload integration with NASA. Ground Support Equipment (GSE) was extensively revised to support the MUSTANG instrument during laboratory calibration and launch site testing.

ON PROGRAMMING TRANSPUTERS TO CAPTURE ADA MULTITASKING FOR THE NPS AUTONOMOUS UNDERWATER VEHICLE

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Advisor: Shridhar B. Shukla-Department of Electrical and Computer Engineering

This thesis is in support of the on-going Autonomous Underwater Vehicle (AUV) project at the Naval Postgraduate School in Monterey, California. This work investigates the development of a transputer-based multiprocessor and how to program it using Ada. The objective is to create a software layer that enables intertask communication over a network of transputers to be location invariant and to make the communication process transparent to the user. Ada, being a concurrent high level language, was chosen as the language in which this software layer is to be written. The method of intertask communication developed here captures the Ada rendezvous semantics, provides reliable and efficient delivery of messages between tasks regardless of their locations, and uses a common message format for all communicating tasks. The location invariant property makes the software layer particularly suitable for developing higher level allocation algorithms. The communication is handled by generic tasks common to each transputer and a common mapping function that has the locations of all the tasks. The programmer needs only to conform to a common format of communication when sending messages between tasks and not be concerned with the actual delivery of the message. The software developed was successfully tested and its performance analyzed for a five transputer ring network using the AUV-II data-flow diagram.

ITERATIVE SYSTEM MODELING USING MULTIGRID TECHNIQUES

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Master of Science in Electrical Engineering-December 1991
Advisor: Murali Tummala-Department of Electrical and Computer Engineering

One and two-dimensional system identification and modeling algorithms utilizing multigrid techniques are presented. Finite impulse response (FIR), autoregressive (AR), infinite impulse response (IIR), and 2-D block matrix iterative system modeling algorithms are enhanced and made more efficient using the multigrid methods. The convergence performance of these algorithms is improved with the multigrid techniques. The reduction in the number of iterations required to converge to a solution is realized by forcing the low frequency error components to appear to be at a higher frequency by transferring to a coarser sampling period. Performance comparisons are presented for FIR, AR, IIR, and 2-D block matrix modeling simulations with and without the multigrid techniques employed.

CODED PERFORMANCE OF A FAST FREQUENCY-HOPPED NONCOHERENT BFSK RATIO-STATISTIC RECEIVER OVER A RICIAN FADING CHANNEL WITH PARTIAL-BAND INTERFERENCE

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A frequency-hopping binary frequency shift keying (BSFK) ratio-statistic receiver with multihops per data bit is an effective electronic counter-countermeasures (ECCM) system against partial-band jamming interference. Interference is modeled as Gaussian noise. Orthogonal binary signaling and independent fading diversity is considered over frequency-nonselective, slow fading Rayleigh, Rician, and Gaussian channels. A forward error correcting coding scheme is implemented for a 1/2 rate convolutional code algorithm. The probability of bit error is examined for different levels of diversity, thermal noise, severity of fading, fractions of bandwidth jammed, and jamming power. Uncoded and coded system comparisons are done to determine worst case performance.

THE DESIGN OF AN ADAPTIVE ATTITUDE CONTROL SYSTEM

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This research designed and simulated an adaptive attitude control system for the Crew Equipment/Retriever (*CER*) during autonomous attitude hold and large angle or slewing maneuvers. The CER is a proposed space robot that deploys from the Space Station and retrieves any lost equipment of incapacitated astronauts. The moment of inertia tensor for the CER and acquired target is not known *a priori*. In this research, the moment of inertia tensor is estimated by a Kalman filter and used to update the derived linear quadratic regulator (*LQR*) and quaternion feedback regulator (*QFR*) control laws. Computer simulation results show that during attitude hold the adaptive LQR design stabilizes the CER and provides a more fuel efficient controller effort: as compared with a previously designed nonadaptive minimum time controller and a nonadaptive LQR design. Computer simulation results of slewing maneuvers show that the adaptive QFR design provides a more fuel efficient controller: as compared with a nonadaptive QFR design.

DETECTION OF BINARY PHASE SHIFT KEYED SIGNALS IN EXTREMELY HIGH NOISE LEVELS

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Master of Science in Electrical Engineering-March 1992
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This thesis describes the design of a fully digital Binary Phase Shift Keyed receiver considered for use in a telemetry system in the range testing of torpedoes. The method employed uses a subspace technique called Estimation of Signal Parameters via Rotational Invariant Techniques (*ESPRIT*) to detect the carrier frequency. This method can be used at lower than normal signal-to-noise ratio's. All results were achieved by the use of computer simulations.

CODED ORTHOGONAL SIGNALING

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In this thesis, a new scheme of encoding orthogonal MFSK signals with convolutional codes is proposed. Instead of separating the code and the signals as is done conventionally, here the m outputs of the convolutional encoder of rate k/m are used to select the $M = 2^m$ orthogonal FSK signals. This combined coded system is called trellis-coded modulation MFSK (TCM/MFSK). The free distance of TCM/MFSK) codes is found computationally. Asymptotic coding gains (ACG) of several TCM/MFSK systems relative to uncoded MFSK systems having the same bandwidth efficiency (Bits/s/Hz) are calculated. Both analytic descriptions and natural mapping implementations of TCM/4-FSK with rate 1/2 and TCM/8-FSK with rate 2/3 for several constraint lengths of the convolutional codes are given. The analytic description of TCM/MFSK is also obtained computationally.

SUN SENSOR IMPLEMENTATION USING SOLAR POWER ARRAYS

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Advisor: Randy Wight-Space Systems Academic Group

This thesis explores the feasibility of utilizing a satellite's solar cell power arrays as a sun sensor. Power output of a solar cell is highly dependent on the intensity and direction of sunlight that falls on the panel and thus provides an indication of the sun's orientation. A sun sensor can be obtained by processing the power signal generated in each solar cell panel. This concept was applied to the Naval Postgraduate School's Petite Amateur Satellite (PANSAT), a 26-sided polyhedral shaped satellite with 17 body mounted square panels. Two circuit configurations to meter the power signals generated in the 17 individual solar panels were investigated. It was possible in one configuration to develop a prediction model of each panel's short circuit current versus sun angle. Compensation for seasonal variations in solar flux, solar cell degradation due to radiation and panel temperature variation is required. An estimation of the resulting sun sensor's resolution and accuracy is given.

AUTOMATED PERFORMANCE EVALUATION TECHNIQUE

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The U.S. Navy operates a number of radio receiving and signal collection sites throughout the world. These sites have been modified and upgraded a number of times to incorporate new equipment technology and advanced receiving and data processing systems. In addition, the encroachment of other activities near the sites has increased the levels of radio and electrical noise to harmful levels. The impact of some site modifications and increased noise levels on the ability of the sites to receive and process data from signals-of interest (SOIs) is a major concern. A means to evaluate the positive (or negative) impact of site improvements, site upgrades, and site encroachment on the performance of a site has not been available in past years. To fill this void, a performance evaluation technique (PET) was developed by the staff and students of the Naval Postgraduate School. PET has gradually evolved into a useful analytic tool used during field surveys conducted by the Signal-to-Noise Enhancement Program (SNEP). SNEP teams visit selected sites to assess the impact of site modifications and man-made radio noise on the reception of SOIs. The primary tool used to quantify the impact of factors affecting SOI reception is the PET curve. This thesis describes the steps involved in the PET, the construction and interpretation of PET curves, and new techniques employing a computer to generate PET curves. Examples of curves produced by the new automated process are presented using data from a recent SNEP survey at the Sabana Seca CDAA site.

THE USE OF ELECTRICAL TRANSMISSION LINE THEORY TO PREDICT THE PERFORMANCE OF SPACECRAFT RADIATORS

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The cascade algorithm that is used for extended surface analysis depends on a new parameterization called the thermal transmission matrix to represent a single fin. This thermal transmission matrix, which is intended to replace the more familiar fin efficiency as a design and analysis parameterization, is a linear transformation that maps conditions of heat flow and temperature at the fin tip to heat flow and temperature conditions at the fin base. The cascade algorithm was derived by resorting to an analogy between a fin and the electrical transmission line. The cascade algorithm permits a fin to be subdivided into many subfins each having a thermal transmission matrix and then the individual transmission matrices for each of the subfins can be used, via a simple matrix product to form an overall equivalent thermal transmission matrix for the entire fin. This thesis develops a thermal transmission matrix for the radiating rectangular, trapezoidal, and triangular fins both for the free space and non-free space environments. Test cases have been run and their solutions exactly match those contained in the literature. The thesis concludes with optimization studies for each profile considered where it is observed that simple non-differential equations can be employed to describe the optimum geometry.

A HOPFIELD NETWORK APPROACH TO DIRECT ADAPTIVE CONTROL OF NONLINEAR SYSTEMS

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Advisor: Roberto Cristi-Department of Electrical and Computer Engineering

An automatic control system capable of controlling an unknown nonlinear system is designed using a direct adaptive control scheme, implemented with a Hopfield network. The application of this method to an arbitrary system is discussed in detail and three specific simulation studies are included. These studies include the implementation of the Hopfield network based direct adaptive control system to a linear system, an inverted pendulum, and a nonlinear model of the NPS Autonomous Underwater Vehicle (AUV) with six degrees of freedom. The AUV simulation includes a three dimensional trajectory following algorithm and shows the ability of the Hopfield network to adapt to simultaneous ordered changes in the AUV's depth, speed, and course. Additionally, an analog circuit design is proposed which implements the automatic control scheme without the support of a microprocessor. The circuit was set up in SPICE and the simulation results as well as some limitations of the analog circuit implementation of the Hopfield network are presented.

BACK-PROPAGATION NEURAL NETWORKS IN ADAPTIVE CONTROL OF UNKNOWN NONLINEAR SYSTEMS

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The objective of this research is to develop a Back-propagation Neural Network (BNN) to control certain classes of unknown nonlinear systems and explore the network's capabilities. The structure of the Direct Model Reference Adaptive Controller (DMRAC) for Linear Time Invariant (LTI) systems with unknown parameters is first analyzed. This structure is then extended using a BNN for adaptive control of unknown nonlinear systems. The specific structure of the BNN DMRAC is developed for the control of four general classes of nonlinear systems modelled in discrete time. Experiments are conducted by placing a representative system from each class under the BNN's control. The conditions under which the BNN DMRAC can successfully control these systems are investigated. The design and training of the BNN are also studied. The results of the experiments show that the BNN DMRAC works for the representative systems considered, while the conventional least-squares estimator DMRAC fails. Based on analysis and experimental findings, some general conditions required to ensure that this technique works are postulated and discussed. General guidelines used to achieve the stability of the BNN learning process and good learning convergence are also discussed. To establish this as a general and significant control technique, further research is required to obtain analytically, the conditions for stability of the controlled system, and to develop more specific rules and guidelines in the BNN design and training.

KALMAN SMOOTHER APPLIED TO LACE

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The ability to determine the structural dynamics of space-based platforms from ground-based radar resolved Doppler measurements will aid in the study of control/structure interaction. The Naval Research Laboratory and Lincoln Laboratory conducted an experiment to determine the feasibility of this method. To accomplish this experiment the LACE satellite was equipped with retroreflectors and the ground-based Firepond laser radar facility was employed. Vibrational information is found from the difference between the reflected Doppler frequencies of the retroreflectors. The method of extracting the Doppler separation was to obtain the power spectrum of the heterodyne signal envelope. A pulse-by-pulse processing of the data yields the Doppler separation history over time. Due to a relatively large amount of clutter in the processed data, a filtering mechanism was employed. The histogram technique is the current filtering-based method employed to obtain a Doppler separation history. This thesis addresses the implementation of the Kalman filter algorithm in conjunction with the Rauch-Tung-Striebel fixed-interval optimal smoother algorithm to perform this filtering task. The Kalman smoother filtering-based method of processing the data produced superior results when compared with the histogram filtering-based method.

MULTILEVEL SECURITY WITH DATA COMPRESSION AND RESTRICTED CHARACTERS SET TRANSLATION

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Multilevel military communication security can be implemented with the notion of masterkeys. The naval message traffic is transmitted with restricted character set and optionally the files are compressed. Both character translation and data compression can be used as add-on data encryption. A masterkey is constructed from a set of service keys from which masterkey is allowed to access. This thesis presents the principles of multilevel security with restricted character translation, data compression, and masterkey implementation.

COUPLING LOSSES IN MULTIPLE BEAM ANTENNAS

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Master of Science in Electrical Engineering-September 1992
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The relationship between beam coupling losses in multiple beam antennas and pattern parameters such as beamwidth and sidelobe level is investigated. A computer algorithm to calculate the coupling coefficients for arbitrary number of beams is implemented using MATLAB. Gain-loss data for various array amplitude distributions is presented.

DESIGN OF MICROCONTROLLER SOFTWARE FOR A SATELLITE-BASED FERROELECTRIC CAPACITOR EXPERIMENT

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Advisors: Fred Terman-Department of Electrical and Computer Engineering &
Rudolf Panholzer-Space Systems Academic Group

The Naval Postgraduate School's Space Systems Academic Group is developing a satellite-based experiment to evaluate the electrical properties of ferroelectric capacitors under high levels of ionizing particle radiation. The experiment, called FERRO, is one of three experiments that comprise the APEX mission. The Apex mission is sponsored by the joint Space Test Program and will be launched in late 1992. The processor for FERRO is an Intel 80C196KB 16-bit embedded controller that will perform all aspects of experiment control, data acquisition, and communication with the host satellite processor. The design of systems and communications software to support the experiment is presented. Functional areas addressed by the design include: microcontroller and peripheral initialization; communication between the experiment and spacecraft processors; fault detection/recovery; recovery from loss of power; and development of an IBM PC based program to provide for pre-flight verification and testing of experiment hardware and software.

MICROCOMPUTER SIMULATION OF A FOURIER APPROACH TO OPTICAL WAVE PROPAGATION

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Advisor: John P. Powers-Department of Electrical and Computer Engineering

This thesis uses spatial impulse response theory adapted from continuous-wave Fourier diffraction theory as the basis for a microcomputer program to model transient optical wave propagation. Programs to generate uniform circular and uniform square excitation functions are included, along with examples of the spatial impulse response for each. Additionally, two new excitation functions with circular Gaussian and circular Bessel spatial distributions are modelled for use in future research. All programs have been written using the MATLAB software package. This effort provides a means to analyze the transient optical wave propagation of a spatially filtered optical source.

INCORPORATING AFEWC IMOM AS AN INSTRUCTIONAL ASSET FOR NPS RADAR AND ELECTRONIC WARFARE CURRICULA

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In this thesis, effort is made to incorporate the computer program, Improved Many (Jammers)-on-Many (Radars) (IMOM), into radar and electronic warfare curricula at the Naval Postgraduate School. The IMOM program is used operationally by the U.S. Air Force for electronic combat mission planning. IMOM allows the user to evaluate electronic combat effects through computer color graphics display of the electronic order of battle including terrain effects. This same program used in an academic role, provides students in radar and electronic warfare a tool for understanding radar principles, jamming principles, and the physical interaction between the two. The objective is to provide a visible link between radar range theory presented in coursework and the two-dimensional electronic combat scenarios presented by IMOM. This is done by plotting the theoretical results for radar signal return, jammer return, and the jamming to signal ratio for both self protection and stand-off jammers. A MATLAB program is used to generate plots of the radar and jamming equations and to validate the IMOM algorithm against the equations used at NPS. The effect of radar parameter changes on the system is clearly displayed, both on the graphical MATLAB output and the IMOM graphics display, therefore enhancing the student's understanding of radar and jamming principles.

MINIMUM TIME CONTROL OF A THIRD ORDER REGULATOR

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Advisor: Harold A. Titus-Department of Electrical and Computer Engineering

The optimal minimum time control is applied to a third order regulator. From Pontryagin, the optimal must minimize the Hamiltonian. The control is a function of the states. The state space is partitioned into regions where the optimal is either plus or minus N (the maximum control magnitude) which is bang-bang control.

METHOD OF MOMENTS ANALYSIS OF DISPLACED-AXIS DUAL REFLECTOR ANTENNAS

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Master of Science in Electrical Engineering-March 1992
Advisor: David C. Jenn-Department of Electrical and Computer Engineering

Small symmetric dual reflector antennas suffer from low efficiency due to subreflector blockage of the main reflector and subreflector scattering. These can be reduced by slicing the main dish and translating its rotational axis, along with modifying of the subreflector geometry. This type of design is usually applied to low-frequency reflectors, but high-frequency analysis techniques are used. Consequently the agreement between measured and computed data is not as good as it would be for a rigorous solution such as the method of moments. This thesis modifies and existing method of moments computer code to handle the displaced axis geometry, and computes the radiation pattern and the efficiency of this antenna as a function of geometrical and electrical design parameters. Optimum configurations are identified for several feed types.

EFFECTS OF FADING AND DATA MODULATION ON NONCOHERENT M-SEQUENCE ACQUISITION SCHEMES

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Master of Science in Electrical Engineering-March 1992
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In direct-sequence spread-spectrum systems, successful communications require phase synchronization of the m-sequence in the incoming signal with a locally generated m-sequence at the receiver. Many acquisition schemes which extract the phase of an incoming m-sequence have been studied, but most of them assume coherent demodulation (which is usually not available during acquisition) and/or independent samples (which introduce a loss in the effective signal to noise ratio (SNR). This thesis investigates the performance of two m-sequence acquisition schemes in the presence of fading and data modulation. A fixed sample size test and a truncated sequential test are studied without the usual assumptions of coherent demodulation or independent samples. The effects of fading and data modulation on our schemes' probability of false alarm, probability of detection and test length are thoroughly explored. We find that channel fading in effect induces a loss of signal SNR, but the desired power of the tests can be restored by suitable adjustments in the decision processor. We find that the effects of data modulation are less severe, but more problematic to correct.

THE USE OF CONFORMAL SUBDOMAIN BASIS FUNCTIONS IN THE METHOD OF MOMENTS COMPUTATIONS FOR A THIN WIRE

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The purpose of this thesis is to investigate the use of Conformal Subdomain Basis Functions (CSBF) in the Method of Moments (MM) solution of a thin wire scatterer. The effect of using CSBF on the computed current and the scattered field is investigated by formulating and coding the MM solution for a thin wire loop and comparing the computed results for various loop sizes to measured data and two other MM codes. Significant reduction in the number of segments (and computer memory requirements) are found for loops with circumferences of less than one to two wavelengths for plane wave incidence. From these results, it is concluded that the use of CSBF will significantly reduce the number of segments required for the MM solution of a spiral antenna.

BACKPROPAGATION NEURAL NETWORK FOR NOISE CANCELLATION APPLIED TO THE NUWES TEST RANGES

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Master of Science in Electrical Engineering-December 1991
Advisor: Murali Tummala-Department of Electrical Engineering

This thesis investigates the application of backpropagation neural networks as an alternative to adaptive filtering at the NUWES test ranges. To facilitate the investigation, a model of the test range is developed. This model accounts for acoustic transmission losses, the effects of doppler shift, multipath, and finite propagation time delay. After describing the model, the backpropagation neural network algorithm and feature selection for the network are explained. Then, two schemes based on the network's output, signal waveform recovery and binary code recovery, are applied to the model. Simulation results of the signal waveform recovery and direct code recovery schemes are presented for several scenarios.

DATA COMPRESSION AND ARCHIVING SOFTWARE IMPLEMENTATION AND THEIR ALGORITHM COMPARISON

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Master of Science in Electrical Engineering-March 1992
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Although data compression has been studied for over 30 years, many new techniques are still evolving. There is considerable software available that incorporates compression schemes and archiving techniques. The U.S. Navy is interested in knowing the performance of this software. This paper studies and compares the software. The testing files consist of the file types specified by the U.S. Naval Security Detachment at Pensacola, Florida.

A VLSI DESIGN OF A RADIX-4 FLOATING POINT FFT BUTTERFLY

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Advisor: Herschel H. Loomis-Department of Electrical Engineering

Cyclic Spectrum Analysis is used to exploit the cyclostationary properties of signals and systems. Implementing such a system will require high speed arithmetic processing. Investigations into high speed arithmetic and FFT design are conducted. Integrated circuits of a 45 MHz floating point multiplier, adder, and rate-1/4 radix-4 FFT butterfly, implemented with a 20-bit word size, are presented using the Genesil Silicon Compiler.

MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

ACOUSTICALLY PROBED TAYLOR-COUETTE FLOW APPARATUS

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Advisor: Anthony Atchley-Department of Physics

A Taylor-Couette cell for the investigation of geometrical phase in acoustics has been constructed. The inner and outer cylinders are made of acrylic. The cell has an inner cylinder radius of 9.477 cm, radius ratio of 0.902, and cavity aspect ratio of 49.2. Two high performance d. c. motors can rotate the cylinders independently. The angular speed of the cylinders is monitored by a photo-interrupter. A piezoelectric polymer (PVDF) transducer mounted on the inner cylinder drives the acoustic field in the cavity and a 6.02 mm diameter electret microphone embedded in the wall of the inner cylinder acts as a receiver. Static measurements of the acoustic modes in the annular cavity show good agreement with theory, though measurements at different angular locations of the transducer reveal 2% nonuniformities. The effects of nonuniformities could be overcome by rotating the cylinders at high speeds. The performance under these preliminary tests indicate that an apparatus of this design is suitable for investigations of acoustics in rotating flows.

ACOUSTIC IMPEDANCE OF MATERIALS FROM REVERBERATION TIME

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Advisors: Alan B. Coppens & James V. Sanders-Engineering Acoustics Academic Committee

A theoretical model is derived to calculate the specific acoustic impedance of the absorptive material covering the walls of a cavity. This model will allow the experimental determination of the specific acoustic impedance from the measurement of the reverberation time in a water-filled cavity. The model assumes a wall of low absorption. It can not be used for rigid or pressure release walls and grazzing incidence is excluded.

DESIGN AND FABRICATION OF A FIBER-OPTIC INTERFEROMETRIC ACCELEROMETER SYSTEM

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Advisors: David L. Gardner & David A. Brown-Department of Engineering Acoustics Academic Committee

Two fiber-optic accelerometer designs are presented. The first accelerometer was constructed using two flexural disks between which is a center spindle. Six uniformly spaced screws fasten the disk assembly to a circular, hollow base housing fiber-optic couplers and splices and providing fiber access. The disk edge is elastically restrained. A flat spirally wound coil of optical fiber is bonded to one surface of each disk. Disk surface strains, caused by acceleration, are detected in a push-pull fashion by fiber coils comprising the legs of a Mach-Zender optical interferometer. This sensor demonstrated an acceleration sensitivity of 2.3 $\pm$ 0.1 rad/g over a bandwidth of 150-475 Hz. The resonance frequency was 1.22 $\pm$ 0.05 kHz. The second accelerometer design described exploits the benefits of using a disk material having a significantly slower sound speed than aluminum; in general, a slower sound speed increases the acceleration sensitivity and decreases the resonance frequency. One polycarbonate disk with a simply supported edge condition is fastened between an aluminum cap and an aluminum housing base secured with six uniformly spaced screws. One flat fiber coil in each Mach-Zender interferometer leg was bonded to each disk surface. This sensor demonstrated an acceleration sensitivity of 56.9 $\pm$ 4.0 rad/g over a bandwidth of 30-950 Hz. The resonance frequency was 1.7 $\pm$ 0.05 kHz. Both sensors are compatible with the symmetric 3x3 demodulator developed at the Naval Postgraduate School. The second sensor and demodulator have been integrated and constitute a sensor system, but testing has not been completed.

TIME DOMAIN MODAL BEAMFORMING FOR A NEAR VERTICAL ACOUSTIC ARRAY

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Advisor: James H. Miller-Department of Electrical and Computer Engineering

Ocean acoustic tomography permits the mapping of various properties of a body of water through indirect means. The technique utilizes travel time variations for an acoustic signal to determine the structure of the ocean medium via inverse mathematical methods. The scale of any tomography experiment is fundamentally limited by the signal to noise ratio at the receiver. Through the use of a near vertical acoustic array, normal mode modeling of the local environment and a modal beamformer, array gains are possible which greatly extend the maximum separation between source and receiver. Additionally, the technique provides temporal resolution of the modal components of the arriving signal. A time domain modal beamformer for a near vertical acoustic array has been developed. It has realized a nominal array gain of 6 dB for the Heard Island Experiment vertical array deployed off California. The primary obstacle to the technique remains inadequate array geometry description.

APPARATUS FOR MEASURING THE ABSORPTION OF SOUND BY NOISE IN ONE DIMENSION

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A traveling wave tube for the study of high intensity acoustics has been constructed. The tube has inner diameter two inches and length 70 feet, and consists of seven 10 foot long sections smoothly joined by collars and flanges. Attached to one end is a housing that contains two JBL horn drivers connected to the tube by a "Y" adapter. An anechoic end termination spans the length of the last section. The termination is made of steel wool of tapered density distribution. Pulse reflection measurements yielded an absorption of 40 dB or greater for frequencies of 500 Hz and higher. Reflected signals of the junctions were typically 40 dB down. Linear attenuation measurements indicated no appreciable acoustic losses at the junctions. Sum, difference and second harmonic generation measurements revealed that interactions were occurring in the medium of interest (air) and were not the result of the drivers or intermodulations of the two drivers. The performance under these preliminary tests indicates that the apparatus is suitable for nonlinear acoustics investigations.

SIMULATION OF ACOUSTIC MULTIPATH ARRIVAL STRUCTURE IN THE BARENTS SEA

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Master of Science in Physical Oceanography-June 1992
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James H. Miller-Department of Electrical and Computer Engineering

In support of the Barents Sea Polar Front Experiment (BSPFEX) in September 1992 (Barents Sea Polar Front Group, 1992), the planned 224 Hz tomography signal transmissions from a near bottom sound source to a vertical receiver array consisting of 16 hydrophones were simulated. Acoustic rays were traced to the receiver array at a range of 50 km using the NOAA Hamiltonian Raytracing Program for the Ocean (HARPO). Input to HARPO was a mathematical ocean environment based on historical bathymetric and sound speed data. Acoustic multipath arrival structure was constructed through eigenray searches and estimation of raytube spreading and surface and bottom losses. A resolvability analysis of the simulated arrival structure reveals that there are a total of 49 unique resolvable ray arrivals. Among them, 42 are from individual omnidirectional hydrophones and 7 from plane wave beamforming.

OCEAN BOTTOM MODELING FOR RAY ACOUSTICS

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Master of Science in Engineering Acoustics-December 1991
Advisor: Lawrence J. Ziomek-Engineering Acoustics Academic Committee

Akima cubic spline and spatial Fourier series (SFS) techniques for modeling ocean bottom contours from bathymetric data were comparatively analyzed. SFS methods encountered difficulty in ocean bottom reconstruction despite several enhancements to the fundamental technique. Both Akima cubic spline and SFS approaches proved unsatisfactory in reproducing first- and second-order derivatives for several arbitrarily shaped ocean bottom contours. A simple reflection angle algorithm for arbitrary one-dimensional bottom models was examined and found to be accurate. A graphical demonstration of acoustic ray interaction with the ocean bottom using a variety of mathematical ocean bottom models and the reflection angle algorithm was conducted.

EVALUATION OF THE COMPUTATIONAL VALIDITY OF THE IMAGE MODEL IN PREDICTING THE SOUND FIELD IN A WEDGE-SHAPED LAYER USING ACOUSTICAL RECIPROCITY

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A computer model based on the method of images was used to investigate and calculate the pressure amplitude distribution in a wedge-shaped (tapered) water layer overlying a fast, absorbing bottom. The pressure amplitude of the field was generated and compared at reciprocal positions of source and receiver. The results showed that the ratio of pressure-difference to the pressure when the position of source or receiver was more near the bottom, that is, deeper and more near the apex.

STUDY OF SOUND PROPAGATION IN A WEDGE-SHAPED OCEAN AND COMPARISON WITH OTHER METHODS

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After several years of research, the image theory has been found acceptable to solve the sound propagation problem within a wedge-shaped fluid overlying either a slow or a fast bottom. Some further observations where done in this research. The primary purpose was the development and computer application of a new analysis, the doublet analysis, based on the image theory. In this analysis, the features of the image theory are studied from another point of view, based on a collection of acoustic doublets.

PREDICTING THE UNDERWATER SOUND OF MODERATE AND HEAVY RAINFALL FROM LABORATORY MEASUREMENTS OF RADIATION FROM SINGLE LARGE RAINDROPS

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Master of Science in Physical Oceanography-March 1992
Advisor: Jeffrey A. Nystuen-Department of Oceanography

Large raindrops (greater than 2.2 mm diameter) that strike a water surface at terminal velocity are capable of creating bubbles that radiate significant underwater acoustical energy. Previous studies have revealed a positive correlation between underwater sound spectral levels during rainfall and the number of large raindrops present. Therefore, laboratory measurements have been made of the underwater sound generated by large raindrops. Using the laboratory measurements, smoothed energy density spectra for various sizes of large raindrops are determined. These spectra are then used to compute a predicted underwater sound spectrum due to rainfall for rainfall rates of 15 mm/hr and 100 mm/hr, assuming an exponential (Marshall-Palmer) raindrop size distribution. The resulting spectra are compared to underwater sound spectra measured at sea during periods with similar rainfall rates. The predicted rainfall spectra are comparable to the measured rainfall spectra. Possible reasons for differences are discussed. An inversion technique for obtaining the raindrop size distribution from the rainfall acoustical spectrum is presented. An alternate approach for obtaining the required inversion matrix is suggested for future work.

CONTINUED INVESTIGATION OF THE USE OF PASSIVE RESONATORS TO IMPROVE THE PERFORMANCE OF A LOW FREQUENCY SONAR TRANSDUCER

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Master of Science in Applied Science-December 1991
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In an earlier thesis, Ellsworth showed that the radiated power output (quantified by the gain in radiation resistance presented to the transducer) and directivity of a compact underwater transducer can be significantly improved by the use of a system of resonant scatterers. These resonant scatterers were termed "sympathetic resonators." In th, present work, we verify the precious findings and extend the work to additional cases of interest. Specifically, we (1) employ equations requiring fewer assumptions and implement them using more accurate numerical techniques, (2) reproduce Ellsworth's calculations and provide graphical results for conical and planar circular configurations for the case of six passive acoustic resonators, (3) extend the theory to and provide results for two types of linear arrays of passive acoustic resonators, (4) and finally, we consider an acoustic Yagi-Uda antenna-like configuration of passive acoustic resonators to improve the directivity of an underwater transducer. The results indicate that the conical configuration of six resonators is the best choice in terms of the gain in radiated power output, directivity along an acoustic axis, and minimum required number of resonators.

OSCILLATING MICROBUBBLES CREATED BY WATER DROPS FALLING ON FRESH AND SALT WATER: AMPLITUDE, DAMPING AND THE EFFECTS OF TEMPERATURE AND SALINITY

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Recent studies of underwater sound produced by raindrops have identified trapped bubbles as the principal sound source. Two mechanisms have been described, one for small drops (Type I) and one for large drops (Type II). A study of sound produced by large raindrops (Jacobus, 1991) showed that the underwater sound radiated by raindrops is 45% less in salt water (salinity, 35 ppt) than in fresh water. The same studies also showed that bubbles radiate more energy as the magnitude of the temperature difference between the drop and surface increases. These findings are examined in more detail using the pressure decay curve of both large and small raindrops. Using small raindrops it is shown that bubbles in salt water have a larger damping constant and smaller initial peak pressures than bubbles in fresh water. Reviewing the data from Jacobus (1991) for large raindrops, increasing the absolute temperature difference between the drop and bubble showed little effect on the damping constant, but did increase peak pressure. Since the sound energy radiated by a bubble is directly proportional to peak pressure squared and inversely proportional to the damping constant, the energy radiated by bubbles from raindrops increases with absolute temperature difference and decreases with salinity.

NUMERICAL INVESTIGATIONS OF BREATHER SOLITONS IN NONLINEAR VIBRATORY LATTICES

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Breather solitons in a one-dimensional lattice of coupled nonlinear oscillators are numerically investigated. These are localized nonpropagating steady states that exist at frequencies either below the linear cutoff frequency (corresponding to the extended mode in which all the oscillators are in-phase) or above the upper linear cutoff frequency (corresponding to the extended mode in which each oscillator is 180° out-of-phase with its immediate neighbors). The lattice is damped and parametrically driven. A nonlinear Schrödinger theory, which assumes a modulational amplitude that is weakly nonlinear and slowly varying in space, is compared to the numerical data. The error is roughly 5% at the low amplitudes and 20% at high amplitudes. The regions in the drive parameter plane (amplitude vs. frequency) where the breathers exist are numerically determined and compared to theory. A substantial discrepancy occurs at lower drive amplitudes where the theory predicts that the lower cutoff breather should exist, but where an instability is observed. Also in contrast to the theory, the region of the upper cutoff breather has relatively large areas in which quasiperiodicity occurs or the motion decays to rest. Quasiperiodicity is also observed in the lower cutoff breather. Finally, instead of a global parametric drive, an end drive is investigated. It is found that, for drive frequencies outside the linear propagation band, there is an amplitude threshold for the periodic ejection of "shedding" of propagating breather solitons. The quasiperiodicity that occurs for a global parametric drive may be a consequence of soliton shedding.

SYMBOLIC SOLUTION OF A MULTILAYER OCEAN WAVEGUIDE PROBLEM WITH ARBITRARY, DEPTH DEPENDENT AMBIENT DENSITY AND SOUND SPEED PROFILES

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Master of Science in Engineering Acoustics-December 1991
Advisor: Lawrence J. Ziomek-Department of Electrical and Computer Engineering

The main purpose of this thesis was to obtain the symbolic solution of a multilayer (four fluid media) ocean waveguide problem. The waveguide was assumed to have depth-dependent ambient density and sound-speed profiles in all fluid media, and arbitrarily shaped boundaries between all fluid media. A system of 28 equations in 17 unknowns was generated by satisfying all of the boundary conditions (including the boundary condition at the source) in cylindrical coordinates. The problem was set up as a weighted least squares problem for symbolic solution by the computer program *Mathematica*. Due to software and hardware constraints, a symbolic solution for the most general case was not obtained. However, by making all of the boundaries plane, parallel boundaries, two cases were successfully programmed, yielding symbolic solutions which were verified by comparison to previously known results.

MASTER OF SCIENCE
IN
ENGINEERING SCIENCE

ELEVATED TEMPERATURE PROPERTIES OF A DISPERSION STRENGTHENED AL-[FE, V, SI] ALLOY

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The mechanical properties at elevated temperatures of a new dispersion strengthened Al-Fe-V-Si (FVS1212) alloy were evaluated. Constant extension rate (tension) tests were conducted on an Instron machine and strain rate sensitivity, yield strength and elongation changes with temperature were obtained. The mechanical behavior appeared to change at ≈ 250°C, with intergranular fracture and necking occurring at low temperatures; and transgranular dimples with uniform plastic deformation at high temperatures. Creep tests in tension were conducted and the stress dependence n, of the steady state creep rate was obtained. A change in the n value was seen from 16 down to 4 at low stresses and temperatures. The activation energy for creep was calculated from the slope of steady state creep rate vs. 1/Temperature (1/T) plot and from an iterative technique based on plotting all the data on one curve using an appropriate value of activation energy for the temperature compensated strain rate plotted against the modulus compensated stress. The first technique gave values between 100 kJ/mole - 1000kJ/mole, while the second method yielded 400 (± 20) kJ/mole. The creep behavior of this alloy appeared to exhibit a threshold stress of 7×10^{-4}E.

A COMPARISON OF THREE COMPUTER WEAPON-TARGET ENDGAME SIMULATIONS FOR AIRCRAFT

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Advisor: Robert E. Ball-Department of Aeronautics

This thesis contains a brief description of three computer weapon-target endgame simulations currently available at the Naval Postgraduate School (NPS). The Missile Intercept Capability Evaluation (MICE-II) and the Enhanced Surface-to-Air Missile Simulation (ESAMS) version 1.5 are flyout simulations which contain endgame routines, and the Joint Services Endgame Model (JSEM) version 2.1 is an endgame simulation. JSEM was installed by the author. This thesis has been written for NPS students who want to conduct endgame studies. The major portion contains a comparison of their capabilities and analytical methods. Also included is an analysis of each program's ability to model all of the important physical and geometrical parameters that impact aircraft vulnerability and weapon lethality.

ATOMIZATION [illegible]-10\B_4C GELLED SLURRY FUEL

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The atomization of a gelled boron slurry fuel using two commercially available airblast atomizers was studied at atmospheric pressure in non-reacting flow. The atomization of water was also characterized for comparison. Each atomizer was operated at two different liquid mass flow rates and several air\fuel ratios. Drop size distribution was measured using a Malvern 2600 HSD Laser Diffraction Particle Sizer. Drop sizes acceptable for use in ramjet combustors could be obtained for the gelled slurry fuel from both atomizers. However, this required air\fuel ratios too high for practical applications. It appears that secondary atomization methods or different types of atomizers will be required to obtain high ramjet combustion efficiencies with these fuels if they are to be used over typical ramjet operating envelopes.

DESIGN, DEVELOPMENT AND TESTING OF A PROTOTYPE OPTICAL SYSTEM FOR A NEXT GENERATION MULTIPLEXED IMAGER

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A proof-of-concept experimental validation of a proposed idea for a prototype optical system was conducted. This system will be incorporated into a new type of infrared, optically multiplexed imaging and multispectral imaging system. This system will use two-sided, transmitting-reflecting encoding Walsh masks to form a two-dimensional optical Kronecker product. First, a ray tracing design was made to model the optical system. Then the optical system was prototyped and ronchigrams were photographed to document the aberrations present in the optical system. It was shown that spherical mirrors could be used to accurately reimage an object onto the encoding masks without significantly affecting the optical accuracy of the image. The geometric aberrations resulting from this design did not significantly effect the overall ability to produce the Kronecker product.

STABILITY OF TURNING RATE GUIDANCE AND CONTROL LAWS FOR AUTONOMOUS VEHICLES

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The problem of turning rate guidance and control for autonomous vehicles is analyzed. Control design is based on the dynamic equations of motion for lateral motions, sway and yaw, while guidance design is based on the kinematics. Analytical conditions are derived that enable the two schemes to operate simultaneously without loss of stability. The results are verified by direct numerical integrations of the equations of motion.

FLOW VISUALIZATION STUDIES OF A SIDESLIPPING, CANARD-CONFIGURED X-31A-LIKE FIGHTER AIRCRAFT MODEL

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Advisors: Sheshagiri K. Hebbar & Maximilian F. Platzer-Department of Aeronautical and Astronautical Engineering

A water tunnel flow visualization investigation was performed to study the vortex development and bursting phenomena on a 2.3% scale model of a X-31A-Like fighter aircraft. The main focus of this study was two-fold: First, to study the effects of angle of attack and static sideslip on the model vortical flow field. Secondly, to study the effects of dynamic sideslip motion at two reduced yaw rates. Results indicate that the wing root vortex bursting locations move upstream as the AOA increases; and at constant angle of attach (AOA < 30°) the leeward side vortex bursting location moves backward and outboard with sideslip inputs while the windward side vortex bursting location moves forward and inboard. The vortex asymmetry switches sides at higher angles of attack (AOA) > 30°). The dynamic lag effects, which cause the leeward side vortex to burst earlier than in the static case during the positive sideslipping motion and later than in the static case during the negative sideslipping motion, increase with the magnitude of the sideslipping motion.

PROCESSING, MICROSTRUCTURE AND SUPERPLASTICITY IN AL-MG-MN ALLOYS

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Master of Science in Engineering Science-December 1991
Advisor: Terry R. McNelley-Department of Mechanical Engineering

A thermomechanical processing (TMP) schedule developed in previous work was modified to provide for an increasing strain and strain rate with each rolling pass. Three alloys, Al-10Mg, Al-10Mg-0.2Mn, and Al-10Mg-0.5Mn (compositions in wt. pct.), were processed utilizing this schedule. Samples were obtained following various rolling passes for subsequent microscopy analysis. Materials in both the as-rolled condition and following 25 minutes of annealing were studied. Utilizing backscattered imaging techniques with the scanning electron microscope, the microstructural evolution of these alloys during the TMP was studied. Second phase particles were observed to precipitate on grain boundaries and deformation structures in the intermediate stages of the TMP. In addition, second phase precipitates developed on $NmAl_6$ particles through heterogeneous nucleation in the Manganese containing alloys. Particle stimulated nucleation of recrystallization was observed in the latter stages of the TMP as precipitate particles coarsened. Tensile testing at 300°C demonstrated the superplastic response of each alloy, and showed that the addition of Manganese enhances superplastic response. Strain rate sensitivity coefficients were observed to initially decrease with increasing strain, but then increased with further straining.

MISSILE TOTAL AND SUBSECTION WEIGHT AND SIZE ESTIMATION EQUATIONS

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Master of Science in Engineering Science-June 1992
Advisor: Conrad F. Newberry-Department of Aeronautics

This study utilizes regression analysis to develop equations which relate missile overall and subsection weights and geometries, including wings and fins, to variables which are considered to be the input for a new design in the conceptual or preliminary design phase. These variables include packaging requirements such as maximum length, diameter, and weight, as well as performance characteristics such as mission and range. Data for the analysis was collected from a variety of military, industrial, and academic sources. The generic missile is split into three subsections: propulsion, guidance and control, and warhead. Utilizing single and multi-variable regression analysis, weight estimation equations are developed for the total missile, subsections, and wings/fins based on categorizing the missile by mission: air-to-air, air-to-surface, surface-to-air, or surface-to-surface; and by range: short, medium, or long. Measures of fit are developed and displayed with their associated equations to aid in selection of the optimum equation.

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF HIGH COPPER HSLA-100 STEEL IN 2-INCH PLATE FORM

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The microstructure and mechanical properties of highly weldable high copper HSLA-100 steel in two-inch (50 mm) plate form were investigated in this work. The mechanical property data showed that the steel in the as-quenched and aged conditions not only met the mechanical property specifications of the Navy for HSLA (HY) 100 steels but also satisfied the requirements for HY-130 steels. Optical, scanning and transmission electron microscope studies of the as-quenched plate indicated that the microstructure was a mixture of lath martensite/retained austenite and bainitic ferrite, which is typical of these steels. On aging this microstructure developed the tempered structures usually encountered in HSLA steels. This investigation concludes that: (1) Increased copper HSLA steel meets all the mechanical property specifications of Navy HSLA-100 ksi yield strength steel regardless of heat treatment and plate thickness (up to 50 mm thickness). (2) High copper HSLA-100 steel in 50 mm plate form can fulfill all the mechanical property requirements of Navy 130 ksi yield strength steel with an appropriate temper. (3) The microstructures formed with various heat treatments are consistent with the HSLA-100 CCT diagram and (4) Increasing copper in HSLA-100 steel also increases the toughness as well as the strength, though the dynamics of this process are not clear.

SIMULATION OF A PARALLEL PROCESSOR-BASED SMALL TACTICAL SYSTEM

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Master of Science in Engineering Science-December 1991
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The Simulation of A Parallel Processor-Based Small Tactical System is a part of The Parallel Command and Decision System (PARCDS) Laboratory, which was established in early 1980s to support research for the Navy's AEGIS combat system. Current U.S. Navy's AEGIS system using the standard AN/UYK-7 computers, which has four processors in the computer system. When one of them fails, the system automatically reloads the remaining three processors with software that has a reduced capability. But in probably less than one decade, they will not be capable of handling the increasing demand for some more complex software systems. Military command and decision systems of the next decade must be characterized by economy, speed, stability, reliability, and ease of repair. The transputer features all of these benefits and provides a scalable network of transputers which is relatively easy to design. The need for parallel processing grows more evident daily, since the best high-performance uniprocessor architectures are reaching their limits. The prime objective of this thesis is to model a small tactical system by using a network of transputers to develop the transputer version of the Ada programming language system which models a small tactical system.

MASTER OF SCIENCE
IN
INFORMATION SYSTEMS

AN INVESTIGATION OF REQUIREMENTS TRACEABILITY TO SUPPORT SYSTEMS DEVELOPMENT

Ann Grayson Abbott-Lieutenant, United States Navy
B.A., Stephens College, 1977
Master of Science in Information Systems-September 1992
and
Mona Rose Busch-Lieutenant, United States Navy
B.S., Jacksonville University, 1983
Master of Science in Information Systems-September 1992
Advisor: Bala Ramesh-Department of Administrative Sciences

A primary concern in the development of large-scale, real-time, complex, computer-intensive systems is ensuring that the system meets the specified requirements. Further, the requirements themselves evolve and undergo many changes during the development process. In such a context, it is essential to maintain traceability of requirements to various outputs to ensure that the systems meet the current set of requirements. An empirical study, utilizing focus group and protocol analysis techniques, was conducted with students from the Naval Postgraduate School. Their input, along with current literature, was used to explore factors to be taken into account while developing a model of traceability, and the appropriateness of the two data collection methods in future research.

AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF SOFTWARE SIZE INCREASE ON SOFTWARE PROJECT MANAGEMENT BEHAVIOR

Diana Lawrence Baker-Major, United States Army
B.A., Mount Holyoke College, 1978
Master of Science in Information Systems-March 1992
Advisor: T.K. Abdel-Hamid-Department of Administrative Sciences

Increasing demand for software and increasing shortfalls of programmers have focused efforts to improve software project productivity on the role of the software project manager. The complex dynamics of software project development, and the "visibility" of the project, affect decision making and performance to a large degree. Using the System Dynamics Model for software project management, these and other issues can be evaluated with low financial risk or outlays through simulation of software projects. This thesis investigates the effect of changing one of the dynamics (i.e., size) on the behavior and performance of the project manager by using a simulation of an actual software project in a game environment. Analysis of the results indicates that increased visibility significantly improves project schedule.

A STUDY OF NOVICE SYSTEMS ANALYSTS' PROBLEM SOLVING BEHAVIORS USING PROTOCOL ANALYSIS

Robert Eugene Baker, Jr.-Lieutenant Commander, United States Navy
B.S., University of Southern Mississippi, 1979
Master of Science in Information Systems-September 1992
Advisor: Bala Ramesh-Department of Administrative Sciences

The purpose of this research was to determine the problem solving behaviors of novice systems analysts during the design process. Using protocol analysis, this research found that novice analysts like their expert counterparts used an iterative problem solving process. However, unlike expert analysts, they exhibited a typical working behavior that tended to focus directly on the task at hand while overlooking larger but pertinent issues.

A CONCEPTUAL DATABASE DESIGN OF A NAVAL SHORE COMMAND MANAGEMENT INFORMATION SYSTEM

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Master of Science in Information Systems-March 1992
Advisor: Hemant Bhargava-Department of Administrative Sciences

This thesis explores the creation of a conceptual design for a database that would assist any Naval shore command with its internal information needs. The database is intended to be a multi-user database accessed via a local area network (LAN). The thesis examines the administration and information needs of the command as an interrelated whole rather than as individual divisions and departments. As the Navy changes to meet different world situations, the need for administrative and management information within a shore command has increased. Most shore commands have attempted to meet this need with single-user relational databases. Often these databases are poorly designed and incorrectly implemented. This project uses the enhanced entity relationship model to create a conceptual design for an administrative database. This basic model can be customized to fit the needs of shore command. Fleet Numerical Oceanography Center, Monterey, California was used to represent a typical mid-sized shore command to develop the basic model and prototype.

AN INFORMATION SYSTEMS ARCHITECTURE ANALYSIS FOR NAVAL AIR SYSTEMS COMMAND

Kamin Adrienne Bell-Lieutenant, United States Navy
B.A., Franklin and Marshall College, 1985
Master of Science in Information Systems-March 1992
Advisor: Robert L. Knight-Department of Administrative Sciences

The Naval Air systems Command (NAVAIR) is seeking to improve its information resource management (IRM) through the use of information systems (IS) architectures. Although several attempts have been made, NAVAIR currently has no overall IS plan. Enterprise Architecture Planning (EAP) is a comprehensive planning methodology that allows organizations to rapidly adapt and survive in dynamic environments. The use of EAP and the tools and resources currently available will provide NAVAIR with a strategic advantage in an era of diminishing resources. This thesis presents NAVAIR with an analysis of methodologies and tools which will prove useful in the development of an overall information systems architecture.

CONVERSION AND RETRIEVABILITY OF HARD COPY AND DIGITAL DOCUMENTS ON OPTICAL DISKS

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Master of Science in Information Systems-March 1992
Advisor: Barry A. Frew-Department of Administrative Sciences

Paper documents can be converted into digital form, as a collection of images, or a combination of ASCII text and images. Full text and image document databases, display advantages and disadvantages during scanning and conversion processes. Conversion of paper thesis documents could be eliminated, if thesis documents could be submitted in digital form, for storage on optical disks. Utilizing existing paper thesis documents, image and full text databases were developed and evaluated to determine the best digital form for storage of paper documents. Analysis was performed on a thesis document in digital form, to determine the most feasible format for digital document submission. This thesis concludes that conversion of paper documents to digital form should not be pursued. Instead, thesis documents should be submitted in digital form for direct conversion and storage on optical disks. Follow on thesis research is recommended to build an in-house CD-ROM mastering system for this purpose.

SOFTWARE DEVELOPMENT WITH APPLICATION GENERATORS: THE NAVAL AVIATION LOGISTICS COMMAND MANAGEMENT INFORMATION SYSTEM (NALCOMIS) CASE

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Information systems executives within Department of Defense (DoD) activities are being challenged to build information systems faster, better, and cheaper. A key step in developing information systems that will meet the future needs of DoD organizations is to explore innovative software development paradigms and exploit technological advances of application generators to produce information systems cost-effectively. This thesis examines the concepts, implementation strategies and issues relating to software development with application generators and illustrates, using a case study of the Naval Aviation Logistics Command Management Information System (NALCOMIS) prototyping development effort, the critical success factors required to implement prototyping with application generators in other areas of DoD.

A FRAMEWORK FOR CLASSIFYING AND RESOLVING SEMANTIC HETEROGENEITY IN OBJECT-ORIENTED DATABASES

Michael Thomas Bourque-Lieutenant, United States Navy
B.A., University of Rochester, 1983
Master of Science in Information Systems-September 1992
Advisor: Magdi Kamel-Department of Administrative Sciences

During the past three decades, many organizations have seen a dramatic proliferation of a variety of information systems. Organizations soon discovered the need to access and share data across these different information systems. Under current technology, this integration is usually not possible due to the heterogeneity of information systems. One level of heterogeneity is that of semantics. The objective of this thesis is to build a framework for enumerating, classifying, and resolving the types of semantic heterogeneity that could exist in an object-oriented database model. The framework covers both schema and data content conflicts. The schema conflicts are classified broadly by the level at which they occur. The primary data conflicts covered include inconsistencies and different representations for the same data.

COMMUNICATION MODULE FOR THE MICRO-BASED SMALL PURCHASE CONTRACTING PROGRAM

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Master of Science in Information Systems-March 1992
Advisors: Rodney Matsushima & Kishore Sengupta-Department of Administrative Sciences

This thesis involves research and development of an interface between the small purchase contracting program (APADE jr.) and the Electronic Assisted Solicitation Exchange (EASE) system on COMPUSERV. The communication module enhancement of APADE jr. will enable the small purchase activities to list their contracts on COMPUSERV for access by vendors to retrieve details on contracts offered for bidding. The contractors then would input bid details into EASE for the communications module to retrieve directly into the APADE jr. databases, without the typical manual document review and data entry which buyers must now perform. The thesis conducts an analysis of small purchase operations and examines the feasibility of automation in small purchase activities. Different micro-based procurement programs are compared and EASE operations are analyzed. Finally, the thesis proposes the design and programming of the communication interface between APADE jr. and EASE.

A WEAPONS SYSTEMS DEVELOPMENT DECISION SUPPORT SYSTEM

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B.S., United States Naval Academy, 1979
Master of Science in Information Systems-March 1992
Advisor: Gordon Nakagawa-Department of Operations Research

Defense budget cuts and the recent "peace dividend" have made weapons system development decisions increasingly more difficult and subject to scrutiny. Meticulous planning is required to ensure tax dollars are spent wisely and effectively. This thesis presents a decision support system designed to aid the senior official in making such investment decisions. The system combines a graphical user interface embedded in a hypertext environment with a multiple attribute decision making solution method. Architectures, consisting of weapons systems development projects from each major program within a warfare area, which provide the best overall benefit versus cost are presented as solutions. The hypertext interface allows convenient access to benefit and cost data, and easily displays solutions generated by the multiple attribute decision method.

MODELING OBSERVATION IN INTELLIGENT AGENTS: KNOWLEDGE AND BELIEF

William C. Branley, Jr.
Master of Science in Information Systems-March 1992
Advisor: Hemant Bhargava-Department of Administrative Sciences

In this paper, a method is presented for controlling autonomous agent behavior by filtering the agent's input. Without such filtering, the agent is allowed to have exact knowledge of the state of its domain, resulting in a pattern of performance that is unrealistic and consistently successful. However, filtering that knowledge into beliefs is a way of making it possible for the agent to be unsuccessful some of the time. That is, if the agent is working from beliefs, and the beliefs happen to be wrong, then the agent may not reach its goal at that particular instant. An application for this method - control of an autonomous combat force in a simulation system - is developed and demonstrated in this paper. The algorithm for generating beliefs about battlefield events models the information-gathering system of a combat force. However, this model attempts to simulate the results of the information-gathering system, and not the cognitive or perceptive processes contained in such a system.

THE OBSTACLES ENCOUNTERED IN THE DEVELOPMENT OF SMMS: A CASE STUDY

David G. Broadwater-Lieutenant, United States Navy
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Advisor: William J. Haga-Department of Administrative Sciences

Automated data processing for non-tactical applications afloat was first implemented on large platforms with the SNAP I system. This system provided excellent inventory management, financial and accounting service in the punch card and magnetic tape environment in which it was introduced. Subsequent modifications have been made to take advantage of changing technologies and increased user expectations. Automated data processing on smaller platforms was implemented with the SNAP II program. While serving many of the same functions this implementation was designed separately and for different user group. The SMMS program discussed here in a case format was an attempt to consolidate and enhance the two SNAP programs.

AN INVESTIGATION OF REQUIREMENTS TRACEABILITY TO SUPPORT SYSTEMS DEVELOPMENT

Mona Rose Busch-Lieutenant, United States Navy
B.S., Jacksonville University, 1983
Master of Science in Information Systems-September 1992
and
Ann Grayson Abbott-Lieutenant, United States Navy
B.A., Stephens College, 1977
Master of Science in Information Systems-September 1992
Advisor: Bala Ramesh-Department of Administrative Sciences

A primary concern in the development of large-scale, real-time, complex, computer-intensive systems is ensuring that the system meets the specified requirements. Further, the requirements themselves evolve and undergo many changes during the development process. In such a context, it is essential to maintain traceability of requirements to various outputs to ensure that the systems meet the current set of requirements. An empirical study, utilizing focus group and protocol analysis techniques, was conducted with students from the Naval Postgraduate School. Their input, along with current literature, was used to explore factors to be taken into account while developing a model of traceability, and the appropriateness of the two data collection methods in future research.

THE SOCIAL AND BEHAVIORAL IMPACTS OF INFORMATION SYSTEMS IN THE AUTOMATED OFFICE: A LITERATURE REVIEW

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This thesis attempts to bring about a clearer understanding of the social and behavioral impacts of information systems in the automated office. The methodology used was a literature review of articles written on the subject of information systems in the office environment. The articles were published in a variety of academic and non-academic journals. All of the articles reviewed were published between 1975 and 1990. The articles were divided into eight categories. The categories include communications, ethical/medical concerns, ergonomics, office automation, the office of the future, managerial/organizational aspects, social/behavioral aspects, and training. The conclusion reached in this paper is that little in the way of empirical research has been done on this subject. By identifying, categorizing, and reviewing these articles others will have a framework for future research.

THE DESIGN OF A PROTOTYPE PERSONAL COMPUTER DATABASE FOR THE EXPERT SYSTEM ADVISOR FOR AIRCRAFT MAINTENANCE SCHEDULING (ESAAMS)

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Master of Science in Management-December 1991
and
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Master of Science in Information Systems-March-1992
Master of Science in Management-March 1992
Advisor: Martin J. McCaffrey-Department of Administrative Sciences

The Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS) was originally proposed in 1985 to assist in the scheduling of maintenance discrepancy repair in the organizational squadron environment. This dynamic environment produces a continuous flow of maintenance documentation from each maintenance action. Presently there exists no single system for the maintenance expert to retrieve this information to assist him, or her, in the critical maintenance decision making process. This thesis addresses the design of the ESAAMS database which is of paramount importance to the expert system. Research on the use of the Naval Aviation Logistics Data Analysis (NALDA) database for a personal computer-based database, is documented. Review of other existing naval aviation database systems are included in this research. Based on interviews with experienced fleet aviation maintenance managers, a prototype database design is produced. This thesis concludes with recommendations for further study based upon the findings of this research

SNAP III TRAINING ADMINISTRATIVE SUBSYSTEM INTEGRATED FUNCTIONAL DESCRIPTION

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Master of Science in Information Systems-September 1992
and
William R. Estrada-Lieutenant, United States Navy
B.A., University of South Florida, 1983
Master of Science in Information Systems-September 1992
Advisor: Dani Zweig-Department of Administrative Sciences

This thesis provides a functional description for a shipboard training administrative subsystem designed to supplement the existing shipboard automated administrative management system with the ability to track the training requirements listed in the U.S. Navy Standard Organization and Regulations Manual. Presently, there is no standard automated training administrative application in the fleet and therefore shipboard managers are administratively burdened with keeping all training records manually. The proposed Training Management Subsystem will perform functions in support of planning, monitoring and documenting shipboard training events. The training applications in this subsystem are designed to operate on hardware and software already provided by existing shipboard SNAP systems.

ANCHORING-AND-ADJUSTMENT IN SOFTWARE PROJECT MANAGEMENT: AN EXPERIMENTAL INVESTIGATION

Timothy P. Costello-Lieutenant, United States Navy
B.S., United States Naval Academy, 1985
Master of Science in Information Systems-September 1992
Advisor: Kishore Sengupta-Department of Administrative Sciences

Software project development continues to be characterized by cost overruns, late deliveries, poor reliability and user dissatisfaction. The Systems Dynamics Model of Software Project Management is a quantitative model of software project dynamics that is attempting to gain some valuable insight into the managerial side of developing software systems. The objective of this thesis was to use the Systems Dynamics Model's gaming interface to investigate the cognitive heuristic anchoring-and-adjustment in dynamic decision environments, and its use in software project management. Specifically, subjects were provided with either a low or a high anchor condition to determine the effect on subject productivity estimation and project performance when confronted with dynamic decision making in software project management. The results show that subjects used anchoring to simplify decision making in the complex dynamic environment. There was evidence of bias introduced by the anchor, thereby causing dysfunctional performance.

TACTICAL DECISION MAKING IN INTELLIGENT AGENTS: DEVELOPING AUTONOMOUS FORCES IN NPSNET

Michael E. Culpepper-Captain, United States Army
B.S., Henderson State University, 1982
Master of Science in Information Systems-March 1992
Advisor: Hemant K. Bhargava-Department of Administrative Sciences

This thesis presents a conceptual framework, system architecture, and working prototype for a tactical decision making model. This model was developed within the context of intelligent autonomous forces in combat modeling systems. The goal of this model is to realistically portray the behavior of tactical units operating on the battlefield. In our prototype, tactical decision making principles and heuristics are modeled as rules in a logic programming system, and are implemented in an expert system development environment. The current implementation plans, executes, and monitors its decisions in real-time during the course of the combat simulation. This research also examines several challenges in the modeling and execution of tactical-level decisions of an autonomous force. This thesis is a significant first step in developing fully automated forces that model human tactical decision making.

A PASSWORD COMPARISON: WHICH ONES ARE HARDEST TO BREAK?

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Advisor: Moshe Zviran-Department of Administrative Sciences

Many Password techniques are in use today. This thesis examines five different techniques: User-selected Passwords, Computer-generated Passwords, Passphrases, Cognitive Passwords, and Associative Passwords. Each mechanism is subjected to various attempts to compromise it. The results of these attempts are analyzed in the concluding chapters of the study. Files containing the passwords were imported from a previous study, which had over 150 participants. The attempts to "break" the different mechanisms consisted of crude brute force attacks, elegant brute force attacks, dictionary searches, and intelligent guessing. Not every attack was directed against each mechanism. It was found that user-selected passwords stood the greatest chance of being "cracked," while cognitive passwords were the most resistant to outside "cracking."

APPLICATION OF OPTICAL DISC DATABASES AND RELATED TECHNOLOGY TO PUBLIC ACCESS SETTINGS

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Advisor: Barry A. Frew-Department of Administrative Sciences

Recently developed optical disc technology offers economical, convenient and durable storage of large quantities of data. Advanced data retrieval software allows rapid search of optical discs. A number of commercial and government publishers produce optical disc databases offering enhanced direct access to data, text, or large reference indexes. In library settings direct patron access to optical disc databases has proven popular. This paper examines issues a librarian or information manager should consider before and during implementation of public access optical disc databases. It documents results of a trial optical disc implementation at the Naval Postgraduate School's Dudley Knox Library and a product survey identifying candidate optical disc database products for library use. Computer hardware options for distribution of information from optical discs are discussed. A strategy is presented for further implementation of optical disc databases in the Dudley Knox Library.

IMPLEMENTATION OF A CONFIGURATION AND MAINTENANCE MANAGEMENT SYSTEM FOR LOCAL AREA NETWORKS

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The management of Local Area Networks today is one of the most challenging tasks which face a system manager. The plethora of system software, application software and accessories available combined with the various computer clones, and open architecture present in microcomputers makes tracking Local Area Network configuration and maintenance a very daunting task. This thesis modifies a previous design for a Local Area Network configuration and maintenance database and implements the new design in dBase IV version 1.1 using the Naval Postgraduate School Administrative Science Department Local Area Networks as a prototype database. The database was designed to be simple to use, to protect data integrity and to be expandable to new equipment, new technology and new data applications. Due to its general nature, the Local Area Network Maintenance and Configuration System can be used on virtually any Local Area Network application.

DATA MANAGEMENT: IMPLEMENTATION AND LESSONS LEARNED FROM DEPARTMENT OF THE ARMY DATA MANAGEMENT PROGRAM

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Master of Science in Information Systems-September 1992
and
Gregory A. Hayes-Lieutenant, United States Navy
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Advisor: Daniel R. Dolk-Department of Administrative Sciences

Information systems executives within Department of Defense (DoD) activities are being challenged to develop innovative ways in which information technology can contribute to the streamlining of DoD organizations. A key step in developing information systems that will meet the future needs of DoD organizations is to manage the data resource. This thesis examines the concepts, implementation strategies, and issues relating to data management and illustrates, using a case study of the Department of the Army data management methodology, the critical success factors required to implement data management programs throughout the DoD.

NAVAL POSTGRADUATE SCHOOL SCHEDULING SYSTEM (NPS^3)

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Advisors: Daniel R. Dolk-Department of Administrative Sciences &
David A. Erickson-Department of Computer Science

A database management system, the Naval Postgraduate School Scheduling System (NPS^3), is proposed to support the Naval Postgraduate School schedulers in scheduling academic events and courses for students, instructors and classrooms during an academic quarter. NPS^3 is designed to assist schedulers in the scheduling process by presenting courses to be scheduled based on scheduling priorities. Semi-permanent events are automatically scheduled and entered in relevant student, instructor and room schedules based on predetermined entries in the NPS^3 database. Schedulers are allowed to assign time periods and classrooms to each subsequent course. NPS^3 then enters the scheduling information in the appropriate student, instructor and room schedules before the next course is scheduled. This process continues until the lowest priority course is scheduled. Structured Systems Analysis and Design Methods are used to present NPS^3. High level design specifications are detailed with data flow diagrams, entity relationship diagrams and structure charts.

BUSINESS RE-ENGINEERING: LESSONS LEARNED FROM THE U.S. ARMY CORPS OF ENGINEERS MODERNIZATION PROGRAM

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Master of Science in Information Systems-June 1992
and
Mary Jo Elliott-Lieutenant, United States Navy
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Advisor: Tung X. Bui-Department of Administrative Sciences

This thesis uses the case study approach to discuss the concepts and issues related to business re-engineering and its applicability to DoD. It discusses recent developments in Total Quality Management (TQM), and the Corporate Information Management (CIM) Initiative that have lead to a number of tools such as Activity Based Costing (ABC) and IDEF that may be used as building blocks for a re-engineering framework. Examined in detail is the U.S. Army Corps of Engineers (USACE) information systems modernization program and the factors required to successfully implement business re-engineering.

BUSINESS RE-ENGINEERING: LESSONS LEARNED FROM THE U.S. ARMY CORPS OF ENGINEERS MODERNIZATION PROGRAM

Mary Jo Elliott-Lieutenant, United States Navy
B.A., University of Wisconsin - Madison, 1988
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Master of Science in Information Systems-June 1992
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William R. Estrada-Lieutenant, United States Navy
B.A., University of South Florida, 1983
Master of Science in Information Systems-September 1992
and
Conrad C. Chun-Lieutenant, United States Navy
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Master of Science in Information Systems-September 1992
Advisor: Dani Zweig-Department of Administrative Sciences

This thesis provides a functional description for a shipboard training administrative subsystem designed to supplement the existing shipboard automated administrative management system with the ability to track the training requirements listed in the U.S. Navy Standard Organization and Regulations Manual. Presently, there is no standard automated training administrative application in the fleet and therefore shipboard managers are administratively burdened with keeping all training records manually. The proposed Training Management Subsystem will perform functions in support of planning, monitoring and documenting shipboard training events. The training applications in this subsystem are designed to operate on hardware and software already provided by existing shipboard SNAP systems.

A FRAMEWORK FOR SELECTION OF DSS DEVELOPMENT METHODOLOGY

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B.A., Baylor University, 1979
Master of Science in Information Systems-March 1992
Advisor: Bala Ramesh-Department of Administrative Sciences

Researchers in the area of Decision Support Systems (DSS) have focused for years on development of a single methodology for the development of DSS. Recent literature in this area suggests there is no single accepted definition or set of characteristics for all DSS; decision features vary with every situation; and DSS development should be based on the salient characteristics of a decision situation and the environment in which it exists. This thesis proposes a broad approach, recognizing different decision features (technology levels, participants, structure, environmental factors, and construction approach) require different approaches. An individual should be able to select the appropriate methodology based on known characteristics of DSS as well as its development and usage environment.

SURPLUS VALUE IN ORGANIZATIONAL COMMUNICATION

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This thesis presents a model of communication value as a function of organizational resources consumed in preparing communications. The value to an originator of a communication is based on the perception of the available resources consumed in preparing that communication. An originator consumes resources to satisfy the objective elements of information value (accuracy, timeliness, and relevance) and subjective elements (format and presentation quality). Even when the objective elements of value are satisfied, an originator continues to consume resources in pursuit of enhanced presentation quality through subjective embellishment. An originator is motivated to over-prepare by competition, maintenance of face and self-efficacy mechanisms. A recipient's value function is based on key objective elements of information value. The subjective elements have value only to the extent that they improve the reception of the objective elements. That value diminishes as resources are consumed in preparing a communication. Surplus value is introduced as the difference between a recipient's value and an originator's value of a given communication, at some quantity of resources consumed in preparation.

C^2 INFORMATION MANAGEMENT: DATA FUSION AND TRACK IDs IN A MULTIPLE SENSOR ENVIRONMENT

Timothy Allen Foster-Lieutenant, United States Navy
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Master of Science in Information Systems-March 1992
Advisor: Carl R. Jones C^3 Academic Group

Battle management decision making requires a composite picture of the environment, including identification of moving and stationary "targets". The current state of technology allows large volumes of data to be gathered from multiple sources. Target kinematics and identity features must be derived through fusion of the data. Initial assignment and maintenance of track numbers, the identifying labels, may lead to ambiguity in command and control information management. The problem is discussed in terms of data fusion in a multiple sensor environment, giving particular emphasis to managing track ID numbers in representative architectures. An overview of data fusion provides a framework for the problem of track ID's. A Centralized Architecture, Distributed Architecture, and two Hybrid Architectures are developed focusing on design tradeoffs. System evaluation using the Analytic Hierarchy Process furnishes the reader an illustration of a process which might be used to select an optimal architecture. This research does not attempt to propose a specific design, but identifies several key criteria which must be evaluated and suggests a framework for comparative analysis.

THE EFFECT OF INFORMATION SYSTEMS ON MIDDLE MANAGEMENT IN THE AEROSPACE INDUSTRY: THE WESTCO CASE

Steven Lee Gaudreau-Captain, United States Marine Corps
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Master of Science in Information Systems-March 1992
Advisors: Kishore Sengupta & Frank Barrett-Department of Administrative Sciences

This is a Case Study involving a company in the aerospace industry. The case attempts to analyze the trends of decentralization in an organizational structure. Additionally, the analysis will probe the effects these trends are having on middle management positions. The time frame of this thesis includes economic recession and a significant strategy shift due to current world situations. Organizational strategy, culture, subcultures, mission priorities and education are just a few of the elements that will be reviewed as contributors to these issues.

THE DEVELOPMENT OF A SCHEDULING APPLICATION IN SUPPORT OF THE PAPERLESS SHIP

Richard John Hale-Lieutenant, United States Navy
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Master of Science in Information Systems-March 1992
Advisor: C. Thomas Wu-Department of Computer Science

The scheduling of events aboard U.S. Navy ships is a complex and dynamic problem. Currently, this process is primarily manual and involves searching through several manuals and instructions to find information. Many times the schedules produced are inaccurate, which can make conducting activities very difficult and result in crew frustration. By automating some of the functions of the scheduling process, accurate schedules can be quickly produced. As a result, valuable time will be saved and the planning and coordination of shipboard activities can be effectively accomplished in order to achieve and maintain a high level of readiness. This thesis is part of the ongoing Argos research project which supports the Navy's paperless ship concept by eliminating or minimizing manual procedures used on ships.

A CLEARINGHOUSE FOR SOFTWARE REUSE: LESSONS LEARNED FROM THE RAPID/DSRS INITIATIVES

Gerard R. Harms-Lieutenant Commander, United States Navy
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Master of Science in Information Systems-September 1992
and
Tina H. Van Hook-Lieutenant, United States Navy
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Master of Science in Information Systems-September 1992
Advisor: Tung X. Bui-Department of Administrative Sciences

Information systems executives within Department of Defense (DoD) activities are being challenged to develop innovative ways in which information technology can contribute to the streamlining of DoD organizations. Software Reuse is a key strategy in developing information systems that will meet the future needs of DoD organizations. This thesis examines the concepts, implementation strategies, and issues relating to the creation of a clearinghouse to facilitate and promote software reuse. Specifically it studies the Defense Software Repository System (DSRS), a DoD version of the Reusable Ada Products for Information Systems Development (RAPID) effort.

DATA MANAGEMENT: IMPLEMENTATION AND LESSONS LEARNED FROM DEPARTMENT OF THE ARMY DATA MANAGEMENT PROGRAM

Gregory A. Hayes-Lieutenant, United States Navy
B.ACCTY., *University of Mississippi*, 1985
Master of Science in Information Systems-September 1992
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Master of Science in Information Systems-September 1992
Advisor: Daniel R. Dolk-Department of Administrative Sciences

Information systems executives within Department of Defense (DoD) activities are being challenged to develop innovative ways in which information technology can contribute to the streamlining of DoD organizations. A key step in developing information systems that will meet the future needs of DoD organizations is to manage the data resource. This thesis examines the concepts, implementation strategies, and issues relating to data management and illustrates, using a case study of the Department of the Army data management methodology, the critical success factors required to implement data management programs throughout the DoD.

THE DESIGN AND IMPLEMENTATION OF ZTRAX: A TRAINING, READINESS AND FLIGHT HOUR RELATIONAL DATABASE MANAGEMENT TRACKING SYSTEM

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B.A., Flagler College, 1985
Master of Science in Information Systems-March 1992
Advisor: Robert L. Knight-Department of Administrative Sciences

In an era of diminishing budgets, information technology must help direct operational commanders in the maximum utilization of their available resources. The institution of a relational database management system to identify and exploit an organization's strengths will aid in keeping forces combat ready at all times. The design and implementation of ZTRAX; a training, readiness and flight hour relational database management system. ZTRAX is expected to provide historical information of home and deployed, operational and training flight evolutions which will aid in the process of training and readiness planning. The ZTRAX application was implemented in November, 1991 and is a menu driven program which permits the addition, editing and querying of data contained on two source documents; the Monthly Training and Readiness Report and the Monthly Flight Hour Report. ZTRAX is run concurrently from within the Paradox program to permit a vast array of ad hoc queries, reports and the importation of graphical display mechanisms.

DEVELOPMENT AND IMPLEMENTATION OF INFORMATION SYSTEMS AT TWO CALIFORNIA WATER DISTRICTS

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This thesis examines the contrasting approaches taken in the development and implementation of computer-based information systems at two water districts. The first water district, a relatively large organization, employed only professionals to plan and closely monitor its information system installation. Eventually, the installation was completed ahead of schedule and below the estimated cost. The second water district, a relatively small organization, primarily used in-house personnel to plan and install its information system. This project experienced time and cost overruns. Besides personnel factors, the following issues affected the markedly different experiences of these two districts: 1) planning; 2) implementation management; and 3) the degree of end user involvement in the project. The goal of this thesis is to assist organizations that may be planning similar projects by analyzing the successes of and mistakes made by these two water districts.

COMPARATIVE ASSESSMENT OF U.S. MARINE CORPS DISASTER RECOVERY PLANS FOR INFORMATION SYSTEMS

Peter J. Hural-Major, United States Marine Corps
B.S., Pennsylvania State University, 1978
Master of Science in Information Systems-September 1992
Advisor: William J. Haga-Department of Administrative Sciences

This thesis sets out the basic elements that constitute disaster recovery plans for information systems in DoD based upon a review of private industry plans and DoD requirements. One of the U.S. Marine Corps plans is presented for comparison to the model plan. A disaster planning checklist to organize and schedule future work in developing a plan and an outline of the U.S. Marine Corps' plan are provided. Conclusions are drawn from the comparison and recommendations are put forth for DoD disaster recovery planning to protect information systems.

DIAGNOSTIC EXPERT SYSTEMS USE IN THE UNITED STATES NAVY

Robert J. Ivey, Jr.-Lieutenant, United States Navy
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Master of Science in Information Systems-March 1992
Advisor: Marty J. McCaffrey-Department of Administrative Sciences

This thesis examines the use of expert systems for equipment diagnostics in the Navy. Diagnostic expert systems have the potential to significantly improve fleet readiness by ensuring quick and efficient repair of downed equipment. This thesis provides a brief explanation of expert systems and a look at their core components. It looks at how the Army, Air Force, and industry are using diagnostic expert systems. It describes several diagnostic expert systems under development in the surface Navy as well as one program that has been fielding these systems for several years. Finally, several conclusions about the Navy's work in this area are presented along with recommendations for further study.

RE-ENGINEERING SOFTWARE SYSTEMS IN THE DEPARTMENT OF DEFENSE USING INTEGRATED COMPUTER-AIDED SOFTWARE ENGINEERING TOOLS

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Master of Science in Information Systems-September 1992
Advisor: Martin J. McCaffrey-Department of Administrative Sciences

The Department of Defense (DoD) is plagued by severe cost overruns and delays in developing software systems. Existing software within DoD, some developed 15 to 20 years ago, require continual maintenance and modification. Major difficulties arise with maintaining older systems due to cryptic source code and a lack of adequate documentation. To remedy this situation, the DoD, is pursuing the integrated computer-aided software engineering (I-CASE) procurement as a means to improve DoD's development and maintenance of software systems. This study focuses on the concepts and theory behind software re-engineering. In particular, it studies the current state of I-CASE technology, and the feasibility of re-engineering existing software systems for migration to an I-CASE environment.

ANALYSIS, DESIGN, AND IMPLEMENTATION OF A DATABASE MANAGEMENT SYSTEM FOR THE NAVAL POSTGRADUATE SCHOOL ALUMNI ASSOCIATION

Mark Todd Kohlheim-Lieutenant, United States Navy
B.S., Oregon State University, 1982
Master of Science in Information Systems-September 1992
Advisor: Shu Sheng Liao-Department of Administrative Sciences

The Naval Postgraduate School Alumni Association is a professional group consisting of graduates from the Postgraduate School. The Alumni Association is a self-supporting entity that is not part of the administrative structure of the school. The Alumni Association supports itself through membership fees paid by graduates who join the association. The administrative work required to run the association is accomplished through a part-time employee and volunteers. Until recently, the Alumni Association was unorganized and lacked a firm plan of action to establish itself with the School's graduates and to increase its membership base. Records of graduates were located in various locations and in different formats which made tracking and contacting alumni an extremely time consuming operation. This thesis develops a database management system for the Naval Postgraduate School Alumni Association. This system provides a standardized format for storing data and tracking alumni. It also performs the time consuming accounting and billing functions associated with the Association's membership management. This thesis provides an outline covering the Alumni Association's system requirements analysis and design methodology. The system was written using dBASE IV, version 1.1.

A DATABASE TO SUPPORT DOD BUSINESS PROCESS REDESIGN

William C. Kotheimer, Jr.-Lieutenant, United States Navy
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Master of Science in Information Systems-September 1992
Advisor: William J. Haga-Department of Administrative Sciences

This thesis describes the development of a database to support business process redesign in the Department of Defense (DoD). Business process redesign is rapidly becoming an important part of DoD's Corporate Information Management (CIM) initiatives. DoD is changing the way it does business in order to meet its commitments with fewer resources. In describing the development of a database to support business process redesign, this thesis reveals insights into the methods and practices that are changing the way business is practiced. The challenge encountered in this project is that the *process* of business process redesign in DoD is being developed concurrently with the database. In effect, the database is built to support a process that is itself not fully understood. It was found that sufficient information on business process redesign existed and could be quantified in such a manner as to be made available in a database format. The development of a prototype database progressed to a stage where it could be implemented. The next step is to build a fully functional model of the database in order to evaluate its role in supporting business process redesign.

THE IMPACT OF COGNITIVE FEEDBACK ON THE PERFORMANCE OF INTELLIGENCE ANALYSTS

Geraldine Susan Krotow-Lieutenant, United States Navy
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Master of Science in Information Systems-March 1992
Advisor: Kishore Sengupta-Department of Administrative Sciences

Human judgement and the process of decision making has been studied in depth for the past century. More recent research has revealed that feedback is a primary element in the decision making process. Feedback has been categorized according to its role in decision making. Some categories of feedback include cognitive, feedforward, and outcome. Cognitive feedback may hold the most promise for positively affecting decision making. Naval Intelligence analysis is a complex process which involves human judgement and decision making on a daily basis. This thesis sought to determine that cognitive feedback would enable intelligence analysts to make optimal choices more consistently than if they were presented with just outcome feedback. Naval Intelligence analysts were the subjects of an unclassified experiment which captured a realistic task performed routinely by analysts in the Fleet. The experiment revealed that cognitive feedback produced the most accurate and optimal results, and indicates that intelligence analysis would benefit from decision support systems that incorporate the element of cognitive feedback.

DECISIONMAKING IN MILITARY COMMAND TEAMS: AN EXPERIMENTAL STUDY

Christopher James Lane-Captain, United States Army
B.A., Trinity University, 1983
Master of Science in Information Systems-March 1992
and
John Wesley Monk-Captain, United States Army
B.S., United States Military Academy, 1983
Master of Science in Information Systems-March 1992
Advisors: Kishore Sengupta & Carl R. Jones-Department of Administrative Sciences

This study examines the role of resource allocation in naval command teams. The experiment is based on the Composite Warfare Commander-Distributed Dynamic Decisionmaking (CWC-DDD) paradigm and investigates the impact of uncertainty in neutral/enemy discriminability, team information structure, and leader's involvement in resource coordination. Seven four-member teams, consisting of military officers, used the CWC-DDD to combat a pre-programmed air threat to a naval battle group. Results show that increased average resource effectiveness and higher average identification confidence lead to greater final team strength. However, increased upward communications lead to lower final team strength. Functional (tactical vs. non-tactical) variations in military background have a significant impact on team performance. Teams that are predominantly tactical develop more coherent strategies, more effectively utilize their resources and have better team performance. Teams that are non-tactical develop limited strategies, assign lower confidence to their target identifications and have more upward communications.

A FRAMEWORK FOR CLASSIFYING AND RESOLVING SEMANTIC CONFLICTS USING THE ENHANCED ENTITY-RELATIONSHIP MODEL

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Master of Science in Information Systems-September 1992
Advisor: Magdi Kamel-Department of Administrative Sciences

In today's organizations, information in current databases is stored in a variety of heterogeneous systems and data organizations. This situation causes problems when trying to integrate them into a federated or multi-database solution. Particularly troublesome is semantic conflict, or differences in the meanings of data structures and definitions in heterogeneous databases. This thesis proposes a systematic approach towards identifying, classifying and resolving semantic conflicts. Using an entity relationship approach as the integrating model, a framework is developed which describes all possible semantic conflicts among the underlying schemas. This framework can be employed as a methodological tool during an integration effort. Possible resolution strategies are offered for each type of conflict and applied to the separate databases to realize a common global schema which could be used to formulate effective queries against the total original volume of data.

EVALUATION OF A USER INFORMATION SATISFACTION SHORT-FORM INSTRUMENT

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Master of Science in Information Systems-March 1992
Advisors: Moshe Zviran & Kishore Sengupta-Department of Administrative Sciences

The objectives of this thesis were to validate and evaluate the Baroudi and Orlikowski [2] short-form UIS instrument as a surrogate measurement of effectiveness of the Department of Defense's Composite Health Care System (CHCS). Hurd [1], using the short-form UIS instrument at the Naval Hospital Charleston, suggested that a fundamental change in the instrument's structure due to significant impact of contractor's services with the CHCS. The three Navy CHCS operational testing and evaluation hospitals were used in this study. The short-form UIS instrument was found to be inadequate for evaluation of overall UIS of the CHCS. Limitations found were: a fundamental change in the factor structure; unevenly distributed variables in a couple of factors; low reliability in one factor; no assessment of user interface with the system; and inconsistent convergent validity findings. A proposed re-design is presented. Statistically significant differences in UIS between groups and sites were found for the four factor solution. Participants were divided into three functional user groups: Physicians, Medical Support, and Administrative Support. All three groups were satisfied with the local Management Information Department staff and services and the system's output. All three groups were dissatisfied with the contractor services. Physicians were significantly less satisfied in three out of the four factors. No significant correlation between time of use of the system and UIS was found, except for the Administrative group's positive correlation with the system's output.

THE STRUCTURE OF THE COMPUTER INDUSTRY

Roger L. McDonald, III-Captain, United States Army
B.S., United States Military Academy
Master of Science in Information Systems-March 1992
Advisor: William J. Haga-Department of Administrative Sciences

This study updates the assessment of the industrial and market structure of the computer manufacturing and software development industries. It describes the structure of these industries in terms of market concentration, barriers to entry, organizational strategies, and legal issues. It also examines the impact of the PC revolution on the market structure of computer manufacturing and software development. Additionally, it describes and analyzes events in computer manufacturing and software development since the late 1980s in terms of alliances, mergers, and market concentration, as the computer industry shakes out marginal participants and re-aligns the market power and technology rights of major players. The study forecasts a ten year scenario for the evolution of the computer manufacturing and software development industries by extrapolating from recent events and from histories of similar mature industries.

ANALYSIS OF MULTIMEDIA INFORMATION SYSTEMS FOR THE U.S. COAST GUARD

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Master of Science in Information Systems-March 1992
Advisor: Barry A. Frew-Department of Computer and Information Services

This is a descriptive study of multimedia information systems, their current and potential uses, benefits, and drawbacks to provide the basis for implementation of multimedia technology in the U.S. Coast Guard. Multimedia is generally considered to be a mix of text, graphics, sound, and static or full-motion video in an information system. In recent years, there has been a dramatic surge in the introduction of new multimedia products and the integration of multimedia with more conventional computing. These new applications include databases that use video images or audio recordings, teleconferencing, PC-based video production editors, and audio/music synthesizers, plus many more. Multimedia was found to be a positive development in information technology and is expected to be popularly accepted in very short order. The Coast Guard is not now implementing multimedia technology in its mainstream information processing functions, although several research and development projects involving multimedia are currently in progress. Recommendations are made for earliest evaluation of the new technology and some general implementation guidelines.

DECISIONMAKING IN MILITARY COMMAND TEAMS: AN EXPERIMENTAL STUDY

John Wesley Monk-Captain, United States Army
B.S., United States Military Academy, 1983
Master of Science in Information Systems-March 1992
and
Christopher James Lane-Captain, United States Army
B.A., Trinity University, 1983
***Master of Science in Information Systems*-March 1992**
Advisors: Kishore Sengupta & Carl R. Jones-Department of Administrative Sciences

This study examines the role of resource allocation in naval command teams. The experiment is based on the Composite Warfare Commander-Distributed Dynamic Decisionmaking (CWC-DDD) paradigm and investigates the impact of uncertainty in neutral/enemy discriminability, team information structure, and leader's involvement in resource coordination. Seven four-member teams, consisting of military officers, used the CWC-DDD to combat a pre-programmed air threat to a naval battle group. Results show that increased average resource effectiveness and higher average identification confidence lead to greater final team strength. However, increased upward communications lead to lower final team strength. Functional (tactical vs. non-tactical) variations in military background have a significant impact on team performance. Teams that are predominantly tactical develop more coherent strategies, more effectively utilize their resources and have better team performance. Teams that are non-tactical develop limited strategies, assign lower confidence to their target identifications and have more upward communications.

NAVAL POSTGRADUATE SCHOOL SCHEDULING SUPPORT SYSTEM (NPS^4)

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Master of Science in Information Systems-March 1992
and
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Master of Science in Information Systems-March 1992
Advisors: Daniel R. Dolk-Department of Administrative Sciences &
David Erickson-Department of Computer Science

A decision support system, the Naval Postgraduate School Scheduling Support System (NPS^4), is proposed to assist schedulers in developing schedules for students, instructors and classrooms for the academic quarter and final examination week. Historical aspects of course scheduling at the Naval Postgraduate School (NPS) are described, and the current course scheduling process (1992) at NPS is analyzed. Its requirements, high-level specifications, and design elements are described in detail. An analysis of alternatives, future considerations for designing and implementing the proposed decision support system, and a prototype user interface are presented.

NEGOTIATION SUPPORT SYSTEM'S IMPACT ON THE SOCIO-EMOTIONAL ENVIRONMENT: A RESEARCH DESIGN FRAMEWORK

John Bradford Owen-Lieutenant, United States Navy
B.A., Jacksonville University, 1985
Master of Science in Information Systems-March 1992
Advisor: Tung X. Bui-Department of Administrative Sciences

The goal of this thesis is to examine the negotiation/conflict environment and develop some proposed effects that Negotiation Support Systems (NSS) have on the socio-emotional climate. This introduction of NSS into the negotiation cycle is expected to change the way in which bargaining parties interact. Normative and socio-emotional biases, while not completely eliminated, may be controlled and limited to a degree. This study suggests that shared use of NSS during negotiation helps users by structuring the session to better refine the party's objectives and tactfully convey them to the other party. Additionally, through better appreciation of the strengths and weaknesses of the other party's position and arguments, interest differentials may be identified more quickly and thus negotiations may move toward a more integrative solution. A proposed research design is presented to evaluate whether use of NSS can *improve* resource consumption, decision quality, perceived fairness, perceived satisfaction, and working relationships.

THE DESIGN OF A PROTOTYPE PERSONAL COMPUTER DATABASE FOR THE EXPERT SYSTEM ADVISOR FOR AIRCRAFT MAINTENANCE SCHEDULING (ESAAMS)

Magno O. Pasadilla, Jr.-Lieutenant, United States Navy
B.A., University of Texas at Austin, 1984
Master of Science in Information Systems-March 1992
and
Dennis K. Christensen-Lieutenant Commander, United States Navy
B.S., University of Florida, 1978
Master of Science in Information Systems-December 1991
Advisor: Martin J. McCaffrey-Department of Administrative Sciences

The Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS) was originally proposed in 1985 to assist in the scheduling of maintenance discrepancy repair in the organizational squadron environment. This dynamic environment produces a continuous flow of maintenance documentation from each maintenance action. Presently there exists no single system for the maintenance expert to retrieve this information to assist him, or her, in the critical maintenance decision making process. This thesis addresses the design of the ESAAMS database which is of paramount importance to the expert system. Research on the use of the Naval Aviation Logistics Data Analysis (NALDA) database for a personal computer-based database, is documented. Review of other existing naval aviation database systems are included in this research. Based on interviews with experienced fleet aviation maintenance managers, a prototype database design is produced. This thesis concludes with recommendations for further study based upon the findings of this research

RISK ASSESSMENT OF LAN COMMUNICATIONS

Mark Alan Paylor-Lieutenant Commander, United States Navy
B.S., Central Washington University, 1980
Master of Science in Information Systems-September 1992
Advisor: William J. Haga-Department of Administrative Sciences

The National computer Security Center's (NCSC) *Computer Security Requirements - Guidance for Applying the DoD TCSEC in Specific Environments* (CSC-STD-003-85) describes an environmental evaluation process which can be utilized to determine the level of trust required in a given Local Area Network (LAN) system for processing sensitive information. This thesis investigates the environmental evaluation process and applies it to the LAN environment of a hypothetical naval aviation squadron.

A COMPARATIVE EVALUATION OF COMPUTER ACCESS CONTROLS

Timothy B. Pence-Lieutenant, United States Navy
B.S., United States Naval Academy, 1984
Master of Science in Information Systems-March 1992
Advisor: Moshe Zviran-Department of Administrative Sciences

This thesis reports the results of a study which tested participants' abilities to recall five different types of computer passwords. Each participant was assigned in a randomized procedure to one of six response intervals. Recall testing of computer-generated passwords, user-created passwords, passphrases, associative passwords and cognitive passwords was conducted using a computer program which simulated system log-on procedures. This study indicates the relative merits of these five password types are more difficult to distinguish when data are collected in the realistic setting of a log-on simulation instead of via paper surveys, as was done in previous research.

A PROTOTYPE GRAPHICAL USER INTERFACE FOR CO-OP: A GROUP DECISION SUPPORT SYSTEM
Paul Steven Posey-Lieutenant, United States Navy
B.S., University of Arkansas, 1985
Master of Science in Information Systems-March 1992
Advisor: Tung X. Bui-Department of Administrative Sciences

A properly designed user interface has the potential to greatly enhance an application by reducing user effort and enhancing interaction. This thesis designs and develops a prototype Graphical User Interface (GUI) for Co-oP, a Group Decision Support (GDSS) for Cooperative Multiple Criteria Group Decision Making. The GUI has been created in a Windows operating environment and intended to be used on an IBM compatible micro-computer. Design methodology builds upon general interface design principles of User Control, Screen Design, and Screen Layout utilizing standard GUI control mechanisms.

CONTINUOUS SPEECH RECOGNITION AS AN INPUT METHOD FOR TACTICAL COMMAND ENTRY IN THE SH-60B HELICOPTER
Richard A. Powers-Lieutenant, United States Navy
B.A., Wake Forest University, 1985
Master of Science in Information Systems-March 1992
Advisor: Gary Poock-Department of Operations Research

An experiment was conducted to determine whether a continuous speech recognition system would reduce the SH-60B Airborne Tactical Officer's taskload. The experiment made use of a Verbex Series 5000 speech recognizer. Ten subjects entered 45 commands frequently used by the Airborne Tactical Officer via two input methods: continuous voice and keying. The experiment was successful and demonstrated that continuous speech recognition is an effective means of reducing the Airborne Tactical Officer's taskload. This thesis discusses the research methodology, reviews and analyzes the data collected, and draws conclusions about the feasibility of incorporating a continuous speech recognition system for command entry in the Sh-60B helicopter.

SECURITY ISSUES IN THE DEFENSE DATA NETWORK
David Allan Prevost-Lieutenant, United States Navy
B.A., University of Texas at Dallas, 1986
Master of Science in Information Systems-September 1992
Advisor: Tung Bui-Department of Administrative Sciences

This thesis provides a discussion of the problems associated with networking in the DDN and will help a local administrator of a DDN subnet identify vulnerabilities. Topics such as authentication and access control, communications security, encryption and detection are discussed in order to gain a better understanding of the DDN and what steps can be taken in order to reduce the risks associated with networking. Recommendations are provided to enable the implementation of an effective program that seeks to reduce these risks to an acceptable level.

ADMINISTRATIVE SCIENCES DEPARTMENT TRAVEL DATABASE SYSTEM

Matthew Curran Ragan-Lieutenant, United States Navy
B.A., University of Washington, 1985
Master of Science in Information Systems-September 1992
Advisor: Tung X. Bui-Department of Administrative Sciences

The Administrative Sciences (AS) Department of the Naval Postgraduate School (NPS) produces a high volume of travel orders and travel claims for both civilian and military personnel. The data used in these documents consists of all departmental personnel and travel data. This database requires constant maintenance to ensure accurate, up-to-date personnel and travel information. This thesis will define, design and implement a database application that the Administrative Sciences Department can use to manage the departmental travel order and travel claim requirements. This new prototype system is names "Travel Database System (TDS)", version 1.0. This thesis provides an in-depth outline covering software requirements analysis, design and implementation. The system was written using OMNIS7 Integrated Development Environment, version 1.03.

EXAMINATION AND IMPLEMENTATION OF A PROPOSAL FOR A PH.D. PROGRAM IN ADMINISTRATIVE SCIENCES

Robert D. Randall, Jr.-Lieutenant, United States Navy
B.S., The University of West Florida, 1985
Master of Science in Information Systems-March 1992
Advisor: Tung X. Bui & Kenneth W. Thomas-Department of Administrative Sciences

The purpose of this thesis is to conduct a feasibility study for establishing a Ph.D. program for the Administrative Sciences department and to prepare a Ph.D. proposal to submit to the Academic Council for program approval. According to the Academic Council requirements regarding the Ph.D. program, the following questions are addressed: (1) does the department have an active master's program; (2) does the department offer adequate physical facilities to support Ph.D. research; (3) is the faculty diverse enough; (4) is the faculty currently active in research; (5) does the faculty have sufficient doctoral program experience; and (6) does the department have sufficient faculty members in the subfield where it is proposed to award the doctorate. The results of this study indicate that the Department of Administrative Sciences meets all the criteria set forth by the Academic Council Policy Manual (Section 259). A strong Administrative Sciences doctoral program would strengthen the Naval Postgraduate School's mission to serve DoN/DoD advanced educational needs.

DETERMINATION OF OPTIMAL TRAINING METHODOLOGIES FOR DISCRETE/DEPENDENT SPEECH RECOGNITION (SR) SYSTEMS

Mark C. Rhoads-Lieutenant Commander, United States Navy
B.S., University of Kansas, 1978
Master of Science in Information Systems-March 1992
Advisor: Gary K. Poock-Department of Operations Research

A research experiment was conducted to determine whether various combinations of training methodologies and speaking voices would affect recognition accuracies amongst unique speaker dependent speech recognition (SR) systems. The experiment used a SR system (VOTAN VTR 6050II) which is based on VOTAN (proprietary) technology. Ten subjects trained five different voice patterns each and conducted four natural voice tests to compile statistics about the recognition accuracy for each pattern. Two patterns (natural voice and declarative voice) were retested using a declarative voice. The experiment was successful and demonstrated that different combinations of training methodologies and speaking voices can significantly affect the performance of unique discrete/dependent SR systems. This thesis discusses the research methodology, reviews and analyzes the data collected, and states conclusions drawn about the particular dependent SR system used in the experiment.

ECONOMIC ANALYSIS OF REDESIGN ALTERNATIVES FOR THE RESFMS INFORMATION SYSTEM

Ron M. Richardson-Commander, United States Naval Reserve
B.A., Point Loma College, 1971
Master of Science in Information Systems-September 1992
Advisors: William J. Haga & Dan C. Boger-Department of Administrative Sciences

This study is a practical example of economic analysis of information systems and of the software cost estimation problem as applied to software development in the Department of Defense. Economic analysis methods and the difficulty of software cost estimation are demonstrated using the proposed redesign of the Reserve Financial Management System (RESFMS), an information system operated by the U.S. Naval Reserve. The mandate for economic analysis in the Department of Defense and procedures applicable to information systems are discussed. Two alternatives are analyzed: the status quo and a redesign proposed by Commander Naval Reserve Force (COMNAVRESFOR). Costs to be considered for each alternative are described. Since the major cost of the redesign will be software development, the problem of software development cost estimation is discussed. An estimate of software development cost is produced. This estimate and other identified costs are used to calculate present value of savings, savings/investment ratio, and discounted payback period for the redesign alternative as compared to the status quo. Risk analysis, using a monte carlo simulation, is then performed to determine the range of possible outcome values and probabilities for each. The result of the economic analysis is a recommendation that RESFMS be redesigned as proposed by COMNAVRESFOR.

A DESIGN FRAMEWORK FOR COORDINATION SUPPORT SYSTEMS

Eric Scott Ringwall-Lieutenant, United States Navy
B.A., Cornell University, 1986
Master of Science in Information Systems-March 1992
Advisor: Tung X. Bui-Department of Administrative Sciences

The aim of this thesis is to develop a model for a coordination support system (CSS) based on a newly synthesized coordination theory and the group decision support system (GDSS) model proposed by Bui and Jarke (1986). Current coordination theory is reviewed and drawn upon to develop a new approach to coordination which is then applied to reach a generic CSS design by establishing modifications to the GDSS model module by module.

AN INTRODUCTION TO X WINDOW APPLICATION DEVELOPMENT

David Michael Rust-Lieutenant, United States Navy
B.S., Rice University, 1986
Master of Science in Information Systems-March 1992
Advisor: Kishore Sengupta-Department of Administrative Sciences

The challenge to developing applications for computer-based windowing systems is generating code for the graphical interface elements. Each windowing system offers its own set of protocols for building the graphical units, but these protocols are rarely portable across different hardware platforms. The X Window System transcends many of these incompatibilities and offers a standard for creating graphics. It is operating system and network independent. However, the basic programming library for X Window offers little sophistication for an application's graphical interface development. Higher level tools make up for the shortcomings of the generic X Window System. This thesis converts an Expert System Knowledge Acquisition and Policy Evaluation program using Cognitive Feedback (ESKAPE/CF) from the Sun View windowing system to X Window. The new application, called XESKAPE/CF, contains the same functionality as the original program even though the migration from Sun View to X Window required an extensive reworking of the program's interface code. The thesis also extends the basic X Window library of functions with more advanced objects. These objects offer additional functionality to the XESKAPE/CF application's interface.

DESIGNING A GRAPHICAL USER INTERFACE FOR A BILATERAL NEGOTIATION SUPPORT SYSTEM

Ralph Sabene-Lieutenant Commander, United States Naval Reserve
B.S., Arizona State University, 1978
Master of Science in Information Systems-March 1992
Advisor: Tung X. Bui-Department of Administrative Sciences

Graphical User Interfaces (GUI) are quickly becoming the standard operating environment for most software programs and operating systems. Ease of use, rapid learning and the ability to retain complex task sequences and operations are some of the advantages attributed to this type of interface. When properly implemented the GUI can provide a natural interaction between the user and the computer. Initial acceptance and continued use of any program can be greatly enhanced by proper design of this interface. It is expected that this trend toward visual representation of a task's objects and actions will be more fully developed and expanded in future years. This thesis explored the principles of interface design with particular attention given to the specific characteristics associated with GUI design. Unique design concepts associated with Negotiation Support Systems were also considered. These design techniques and principles were then applied in the analysis and design of the graphical user interface for a Bilateral Negotiation Support System based on multiple attribute utility theory. The program was written in Microsoft Visual Basic for use under the Microsoft Windows 3.0 operating environment.

COMPUTER VIRUS SECURITY IN DON

Michael Jerome Salters-Lieutenant, United States Navy
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Master of Science in Information Systems-March 1992
Advisor: Roger Stemp-Department of Computer Science

This thesis discusses the growing threat of computer viruses and their impact on Automated Information Systems. In particular, it attempts to show a need to establish sound security programs that properly address computer viruses. A major area of the thesis focuses on current guidance by the Department of Defense and the Department of the Navy and provides recommendation for an effective Navy organization to effectively combat the security threat from computer viruses. This thesis focuses on viruses generally associated with personal computer systems and PC based local area networks. However, the policies, guidelines and organizational measures presented in this paper are applicable to larger computer systems and networks.

AUTOMATED MANPOWER ANALYSIS AND PERSONNEL MANAGEMENT SYSTEM (AMA/PMS)

Cynthia Ellen Schwind-Lieutenant Commander, United States Naval Reserve
B.A., Radford University, 1979
Master of Science in Information Systems-March 1992
Advisor: Magdi Kamel-Department of Administration

In a peacetime environment of increasing budget cuts resulting in reduced manning levels, active management of limited manpower assets is vital to ensure mission accomplishment and battle readiness. Manpower analysis is the process by which an activity's manpower assets are matched to or balanced against authorized billets to determine strengths and weaknesses in manning structure. Manpower analysis must be performed on a continual basis at all Naval activities. Each command must identify, through manpower analysis, future manning shortfalls and take appropriate actions to alleviate them. This thesis presents the data and functional requirements, and logical database design for an Automated Manpower Analysis and Personnel Management System (AMA/PMS). Object-oriented database design methodology was used to define data and functional requirements of the system.

AN EVALUATION OF THE NEED FOR LOCAL AREA NETWORKS AT NAVAL AVIATION SQUADRONS AND WINGS

Campbell P. Shannon-Lieutenant, United States Navy
B.S., Bates College, 1982
Master of Science in Information Systems-March 1992
Advisor: Myung Suh-Department of Administrative Sciences

In the 1990s the Navy faces a new host of challenges. With decreasing defense spending it must find a way to keep its ADP hardware modern. The technological advances in computer technology of the eighties have left the Navy with a non-cohesive strategy for ADP procurement. The Navy spent millions of dollars buying thousands of new micro-computers for the desktops of its ships and squadrons. The nineties are a new decade but the constant development of new computer technology hasn't changed. Should the Navy continue to spend millions of dollars on these new technologies or should it keep on upgrading the computer assets it currently has? This thesis evaluates the Navy's need for one of these new technologies: Local Area Networks (LANS). Should the Navy upgrade its stand alone desktop micro-computers to networked computers or are stand alone desktop computers good enough for the Navy's needs of today and tomorrow? Is there sufficient benefit alone to justify this move to networked computers at squadrons and wings? It was found that Naval aircraft squadrons and wings are the backbone of the Navy's ability to project power. The installation of LANs at these units and the aircraft carriers that they deploy to can provide them with a vital boost in administrative productivity. Selection of LAN technologies should be done on a unit by unit basis. The emphasis of the selection criteria used should be to provide maximum compatibility, upgradability, security, and portability. Finally, there must be a central control group that monitors overall progress with LAN selection and installation.

ADA IMPLEMENTATION ISSUES AS DISCOVERED THROUGH A LITERATURE SURVEY OF APPLICATIONS OUTSIDE THE UNITED STATES

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The Ada programming language has been adopted, mandated and legislated for use by the Department of Defense for all software development where cost effective. Although it is a powerful, general purpose language, Ada has encountered some resistance to its implementation with DoD. However, Ada's use outside DoD, as well as outside the United States, is on the rise. Foreign governments and commercial industries are realizing Ada's benefits throughout the software development cycle. The acknowledgement of Ada's advantages in productivity enhancement and cost saving has initiated a shift towards Ada, away from older programming languages, like Fortran and COBOL. This study aims to disseminate information about the language and its use around the world, as well as discuss negative attitudes which present the biggest challenge to Ada's implementation.

INFORMATION SYSTEMS:
HOW THEY AFFECT AND ARE AFFECTED BY ORGANIZATION STRUCTURE
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Master of Science in Information Systems-March 1992
Advisor: William J. Haga-Department of Administrative Sciences

This thesis identifies the impacts of organizational structure on the implementation/operation of management information systems, as well as the impact of information technology upon organizational structure. The conclusion is that academic researchers have identified not only key elements of organizational structure to facilitate successful information system implementation, but also human factors involved. There is no absolute choice for an information system; only a best fit for matching an information system and an organization's structure.

DESIGN AND IMPLEMENTATION OF A PATIENT TRACKING AND RECALL SYSTEM FOR BRANCH DENTAL CLINIC MONTEREY
Timothy P. Steele-Lieutenant Commander, United States Navy
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Advisor: Hament K. Bhargava-Department of Administrative Sciences

This thesis analyzes the information system requirements of Branch Dental clinic, Monterey, and develops a computer application to automate the clinic's patient tracking and recall process. The application replaces an existing mainframe-based, single-file system with a PC-based, relational database management system that provides greater functionality, enables increased productivity, improves data integrity and accuracy, and includes currently lacking security features and administrative functions.

X WINDOW APPLICATION EXTENSION WITH THE ANDREW TOOLKIT
Jeffrey J. Stenzoski-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1980
Master of Science in Information Systems-September 1992
Advisor: Bala Ramesh-Department of Administrative Sciences

This thesis investigates the extension of an X11 Windows-based application using the high-level Andrew Toolkit to permit direct knowledge base access via a graphical user interface (GUI). Programming with Andrew Toolkit is relatively straightforward, once initial familiarity with the toolkit structure and methodology is achieved.

THE USE OF STATISTICAL MEASURES TO VALIDATE SYSTEM DYNAMICS MODELS

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System dynamics modelers have often been criticized for their informal methods of model validation and for not using more formal, quantifiable measures to lend confidence to the validation process. Numerous proponents of the system dynamics approach have highlighted this shortcoming, however, and have suggested a variety of appropriate statistical measures which could be used in the model validation process. The objective of this thesis is to complement earlier validation efforts of the Abdel-Hamid and Madnick System Dynamics Model of Software Development by submitting the model to a battery of appropriate statistical measures. The model is evaluated with statistics which have been used by others in the system dynamics field. The evaluation makes two different comparisons. First, an evaluative comparison is made between data generated by the model and actual data of two real software projects. Then, an evaluative comparison is made between model generated data and data obtained by direct experimentation for two different experiments, using the model's gaming interface. The two evaluations serve to promote confidence in the model.

DEVELOPMENT OF A FACULTY RESEARCH AND PUBLICATION DATABASE SYSTEM

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Master of Science in Information Systems-September 1992
Advisor: Shu Liao-Department of Administrative Sciences

The Administrative Sciences (AS) Department of the Naval Postgraduate School (NPS) maintains a substantial amount of faculty research and publication data that is used to support its vast and varied informational needs. The data consists of all departmental publications that have been written by Administrative Science faculty members. This database requires constant maintenance to ensure accurate, up-to-date publication information that can be rapidly accessed at anytime. This thesis will define, design and implement a database application that the Administrative Sciences Department can use to systematically manage their faculty publication database for automatic retrieval and reporting. This new prototype software is named "Faculty Research and Publication Database System (FPDS)", version 1.0. This thesis provides an in-depth outline covering software requirements analysis, design and implementation. The system was written using Dbase IV, version 1.1.

COMPARISON OF GRAPHICAL TERRAIN RESOLUTIONS BY SCENARIO FOR THE JANUS (A) COMBAT MODEL

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D.D. Bundy-TRAC-MTRY

The purpose of this thesis is to investigate effects of the graphical terrain resolution of the Janus (A) Combat Simulation Model. Two scenarios were compared at differing terrain resolutions in order to determine if the resolution affects results of the simulation. Several measures of effectiveness (MOEs) were used in the study. The results suggest terrain resolution used in Janus (A) of Fort Hunter Liggett does not impact greatly on the outcome of the simulations of two ground combat scenarios for most MOEs. However, there is enough evidence to suggest that further investigation of graphical terrain resolution should be conducted at higher resolutions.

A CLEARINGHOUSE FOR SOFTWARE REUSE: LESSONS LEARNED FROM THE RAPID/DSRS INITIATIVES

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and
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B.S. University of Villanova, 1978
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Advisor: Tung X. Bui-Department of Administrative Sciences

Information systems executives within Department of Defense (DoD) activities are being challenged to develop innovative ways in which information technology can contribute to the streamlining of DoD organizations. Software Reuse is a key strategy in developing information systems that will meet the future needs of DoD organizations. This thesis examines the concepts, implementation strategies, and issues relating to the creation of a clearinghouse to facilitate and promote software reuse. Specifically it studies the Defense Software Repository System (DSRS), a DoD version of the Reusable Ada Products for Information Systems Development (RAPID) effort.

COMPUTER SECURITY CONCEPTS AND ISSUES IN THE INFORMATION TECHNOLOGY MANAGEMENT (370) CURRICULUM

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Advisors: Tung X. Bui & Roger Stemp-Department of Computer Technology

DoD has become increasingly dependent upon storing its sensitive information in electronic form and has a deep concern for the integrity and privacy of this valuable information. In the recent aftermath of numerous electronic break-ins, the DoD continues to express anxiety over technically weak system administrators' inability to protect sensitive electronic information. The solution to minimizing these electronic intrusions and bolstering computer security in DoD is to educate military officers and federal civilians in the methods of computer security. This can be accomplished by integrating concepts and problem solving techniques related to computer security into the Information Technology Management (370) Curriculum at the Naval Postgraduate School.

MODELING PROCESS REDESIGN

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This thesis introduces the usage of the IDEF (ICAM [Integrated Computer Manufacturing] Definitions Language) methodology to model process redesign. A research team was assembled at the Naval Postgraduate School in Monterey, California to attend a five-day IDEF conference to create a model of process redesign. This model will be used to develop a handbook for functional managers to evaluate and redesign their own business processes.

ADDING INTELLIGENCE TO THE COMPOSITE WARFARE COMMANDER - DISTRIBUTED DYNAMIC DECISIONMAKING (CWC-DDD) PARADIGM

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The Composite Warfare Commander - Distributed Dynamic Decisionmaking (CWC-DDD) paradigm is a tool for experimentation and research into the area of command, control and communications (C3) team decisionmaking process in simulated Navy engagement scenarios. It is implemented as a computer-driven interactive game among four person hierarchical teams of decisionmakers on a network of workstations. The paradigm is a compromise between controllability and realism of the experimental environment. The major drawback with the current implementation is the lack of responsiveness of the tasks (attackers) to the actions of the assets (defenders) and the environmental conditions. This thesis details ways to improve the responsiveness of the attackers and the realism of the paradigm by the implementation of a group of if-then heuristics. The five proposed heuristics are designed to make the attackers attempt to evade the defenders while still actively pursuing their mission to penetrate the center of the battle group. The heuristics are implemented in the RAINCOAT version of the paradigm using the C programming language. The heuristics are validated by several military commanders for adherence with the accepted battle doctrine of the Navy's Composite Warfare Command.

NAVAL POSTGRADUATE SCHOOL SCHEDULING SUPPORT SYSTEM (NPS^4)

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and
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David Erickson-Department of Computer Science

A decision support system, the Naval Postgraduate School Scheduling Support System (NPS^4), is proposed to assist schedulers in developing schedules for students, instructors and classrooms for the academic quarter and final examination week. Historical aspects of course scheduling at the Naval Postgraduate School (NPS) are described, and the current course scheduling process (1992) at NPS is analyzed. Its requirements, high-level specifications, and design elements are described in detail. An analysis of alternatives, future considerations for designing and implementing the proposed decision support system, and a prototype user interface are presented.

FACULTY WORKLOAD DATABASE SYSTEM (FWDS) FOR THE ADMINISTRATIVE SCIENCES DEPARTMENT: ANALYSIS, DESIGN, AND IMPLEMENTATION

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The Administrative Sciences (AS) Department of the Naval Postgraduate School (NPS) has a very large database containing information regarding faculty activity in the areas of course instruction; thesis development, ongoing research, and academic service. Management of this information was disjointed and required considerable time and energy, and could be more efficiently handled with a software application. Subsequently, the choice was made to develop a database application that effectively manages these facets of the AS Department faculty workload. This thesis develops and implements the Faculty Workload Database System (FWDS) to support the AS Department. Additionally, this thesis provides an in-depth discussion of the entire software application analysis, design and implementation process. The system was produced using dBASE IV, version 1.1 and will transition to operational status during FY 93.

MASTER OF SCIENCE
IN
MANAGEMENT

INVENTORY MANAGEMENT OF PHARMACEUTICALS IN AUTHORIZED MEDICAL/DENTAL ALLOWANCE LISTS

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Pharmaceuticals stocked in Authorized Medical/Dental Allowance Lists (AMAL/ADAL) have an ongoing problem of expiration. Due to short shelf-life, Prepositioned War Reserve (PWR) pharmaceuticals inventory require constant monitoring to maintain medical support readiness. The problem associated with pharmaceuticals is the high cost of replacement and disposal. Numerous expired drugs were found in AMALs as a result of inaccurate inventory procedures. Current practices of the Medical Logistics Company were investigated and research was conducted for solutions on the pharmaceutical inventory problem. Cost-benefit studies for a stability program and a bar code system show potentially cost-effective measures to solve the shelf-life problem. The financial as well as the beneficial outcomes of increasing drug stability and implementing transactional inventory methods could help reduce the cost of shelf-life expiration.

ANALYSIS OF A PROPOSAL TO CONSOLIDATE AIRCRAFT INTERMEDIATE MAINTENANCE CAPABILITIES

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This thesis analyzes the potential for consolidating duplicate capabilities of Navy Aircraft Intermediate Maintenance Departments (AIMD) located in the same geographical area. The expected benefits and drawbacks of consolidation are examined. Benefits discussed are manpower reduction, support equipment reduction, inventory reduction, and increased productivity. Drawbacks discussed are transportation costs, facilities modification costs, impacts to customer service, additional maintenance management and administrative responsibilities, and reduced military resiliency. The thesis discusses options regarding the organizational and service levels consolidated, candidates for consolidation, siting of consolidated repair capabilities, and management of consolidated items. The thesis also analyzes commonality in manning, automatic test equipment, and specific component repair capabilities of the two AIMDs located in San Diego, California: Naval Air Station North Island AIMD and Naval Air Station Miramar AIMD.

RECRUITMENT OF QUALITY SOLDIERS
(THE CASE OF THE PAKISTANI ARMY)
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This thesis studies two aspects of Army manpower: (1) quality issues in the Army manpower, and (2) the influence of economic variables (military compensation, advertising, and unemployment rate) on enlistment decision of the youth population, particularly high quality Army recruits. The level of education and scores on applicants' aptitude tests are the basic determinants of soldier quality. However, military training and environmental factors help to improve the quality of soldiers. With regards to the impact of economic variables, basic military pay and education incentives, that is "money for college education," have major influences on enlistment decision of potential high quality recruits. Advertising and unemployment rates also have considerable impact on the enlistment decision. Following a discussion on quality and influence of economic variables, a model is formulated to minimize the Army's total costs subject to a given level of readiness. The model helps to determine the effect of changes in the Army readiness level, education level, unit advertising costs, unit training costs, unemployment rate, and unit equipment costs on the decision variables (manpower level, equipment level, advertising expense/cost, and training expense/cost).

A TAXONOMICAL STRUCTURE FOR CLASSIFYING THE
SERVICES PROCURED BY THE FEDERAL GOVERNMENT
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This thesis was an attempt to develop a taxonomical scheme that practitioners may employ in classifying services that are procured by the Federal Government along a continuum from procurements that are relatively simple to those that are strategically complex. A secondary research objective was to determine what characteristics are appropriate for classifying services on a strategic basis. A literature review, expert interviews, and survey using 20 heterogeneous sample services were conducted to determine the relationship between characteristics and services. Cluster analysis was used to group services into categories with similar compositions of selected characteristics. A taxonomical structure was developed for classifying services into five categories. Potential benefits may arise via application to staffing and directing of procurement functions and refinement of procurement policy. It is recommended that the taxonomical model resulting from this research be validated and refined through further use.

A DATABASE PROCESSING APPLICATION FOR THE DIRECT AIR SUPPORT CENTER

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The Marine Air Command and Control System execution of Direct Air Support is based on the concept of centralized command and decentralized control. It is completed manually using standardized procedures and controls to ensure responsiveness in highly dynamic situations. This thesis investigates the issues in developing and implementing an automated database application for receiving, processing, disseminating, and recording information as it pertains to the Air Tasking Order within the Direct Air Support Center. A relational database design is proposed using Entity-Relationship modeling. A simple prototype of the system is implemented in dBASE IV to demonstrate proof of concept. The major benefit of the database approach is that databases are dynamic and can evolve with changing needs.

COST BENEFIT ANALYSIS OF GENERAL SERVICES ADMINISTRATION's PROPOSED RELOCATION

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and
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General Services Administration is faced with the responsibility of improving its physical distribution capabilities by either upgrading its current facilities or constructing a new facility. A cost/benefit analysis was conducted of all viable alternatives as to the least future cost to the Government while maintaining General Services Administration's current level of service and effectiveness. Of the alternatives analyzed, it was determined that it would be of the utmost benefit to the Government for General Services Administration's Western Distribution Center to relocate at Sharpe Army Depot, current site of a portion of Defense Logistics Agencies Western Distribution Center. At Sharpe, General Services Administration has the greatest potential for cost savings while improving its warehousing ability into the next century. Additionally, there are many potential benefits not addressed, such as consolidation of distribution functions between General Services Administration and Defense Logistics Agency, in order to take advantage of greater cost benefits.

BENEFIT/COST ANALYSIS OF INTERDWELLING NOISE CONTROL IN MULTIFAMILY DWELLINGS

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and
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This thesis was undertaken to perform a benefit/cost analysis of interdwelling noise control in multifamily dwellings. Specifically, the benefit/cost analysis was performed to determine whether multifamily dwelling owners would find it economically beneficial to provide multifamily dwellings that are insulated from interdwelling noise. In other words, does the marginal benefit to the owner (additional monthly rent) exceed the marginal cost of providing the added insulation? A questionnaire was used to survey tenants of one multifamily apartment complex in Monterey, California to show that a market does indeed exist for sound insulated multifamily dwellings (i.e., tenants are willing to pay to attenuate interdwelling noise), and that the amount they are willing to pay is relatively large compared to the marginal cost of providing the added interdwelling sound insulation (i.e., the amount that tenants have to pay for additional sound insulation to make the benefit/cost ratio greater than one is relatively small). The survey also ascertained attitudes toward noise where quiet surroundings are important to tenants in deciding where to rent, where noise is annoying to them to a relatively large degree, and where interdwelling noise is more annoying than outdoor noises.

DOUBLE-STACK CONTAINERS: CHANGING THE IMAGE OF INTERMODALISM

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Intermodalism is seen by some shippers as a new industry emerging within the transportation industry. This thesis provides a basic understanding of the intermodal industry and investigates how the advent of containerization, especially the double-stack container system, has affected the shipper's perception of domestic intermodal transportation. As the double-stack network spreads there are signs that this new industry may be able to resolve the problem of fragmentation which has prevented intermodal service from becoming cost competitive. In addition, containerization and the use of double-stack trains can help streamline the rapid mobilization of military cargo.

FINANCIAL MANAGEMENT OF HAZARDOUS WASTE COMPLIANCE AND MITIGATION COSTS: CONSTRAINTS AND IMPLICATIONS

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This research investigates financial management and other constraints and implications of hazardous waste disposal and compliance within DoD and DoN. It shows that during contracting fiscal period where there is an environmentally conscious public, the DoD and the Navy have to make trade-offs in funding for hazardous waste management. The study reveals that legislation removing sovereign immunity from the DoD for hazardous waste disposal may not achieve its desired results of reducing pollution. Furthermore, the research concludes that DoD currently lacks an effective method of accounting for hazardous waste generation levels. This affects the interpretation of the data for decision making. An accounting model is presented to address this problem to increase the effectiveness of hazardous waste minimization programs.

INTERNAL CONTROL IN AN EDI ENVIRONMENT

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Electronic Data Interchange (EDI) is the electronic transmission of standard business documents in machine-readable format between parent companies and respective trading partners. As the use of EDI has grown, there have been the associated risks due to an uncontrolled environment. Accordingly, the necessity for effective internal controls in an EDI environment is on the rise. This thesis evaluates and analyzes the feasible internal controls in an EDI environment and provides recommendations for further development. It discusses the basic concepts of EDI, general control and application control issues, as well as legal issues related to an EDI environment.

THE ORINCON CONTRACT: A CASE STUDY OF SERVICE CONTRACTING

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Contracting for services within the U.S. Government is full of difficult challenges that face the Contracting Officer on a daily basis. Many problems that develop during contract performance can be avoided through proper planning in the initial stages of the contract cycle. This thesis assesses a Marine Corps Technical Services contract performed at the Marine Corps Tactical Systems Support Activity, Camp Pendleton, California. The analysis focuses on various phases of the contract cycle and the problems encountered during the performance of the contract. A brief history of contracting for services within the U.S. Government is presented, the preparation of the service contract Statement of Work is explored, and a background on the Government Agencies involved with the contract is also provided. The conclusions yield that the post-award problems were a direct result of an insufficiently prepared Statement of Work, resulting in a poorly written contract, and an insufficient administering of the contract. Recommendations concerning these issues are then addressed.

SOFTWARE ACQUISITION: EVOLUTION, TOTAL QUALITY MANAGEMENT AND APPLICATIONS TO THE ARMY TACTICAL MISSILE SYSTEM

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Software acquisition has become the critical path in the procurement of Department of Defense (DoD) weapon systems. Software requirements and their complexity have increased at an exponential rate and support requirements now constitute up to 70 percent of the software life cycle costs. This thesis presents the concept of software Total Quality Management (TQM) which focuses on the entire process of software acquisition, as a partial solution to the software acquisition crisis. A software case study, analysis, and lessons learned with applications to the Army Tactical Missile System (TACMS) is presented. A software process control maturity model, a standard software language, and a set of software metrics are presented. A discussion of program manager's responsibilities to implement a process control mechanism to produce quality software products is presented. The principal finding is that software acquisition is the major challenge to a program manager for weapon systems procurement. The major recommendation of this study is that software TQM can be applied to software acquisition.

AN ASSESSMENT OF THE RELATIONSHIP BETWEEN APTITUDE TEST SCORES AND REPRESENTATION OF BLACKS AND HISPANICS IN U.S. NAVY OCCUPATIONS

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This thesis examines the influence of aptitude test scores on black and Hispanic representation in Navy enlisted occupations (or ratings) from 1982 through 1990. A procedure to control for the influence of aptitude test scores is introduced and explained along with a system for categorizing enlisted ratings by their relationship to the Navy's stated mission. Graphical depictions of black and Hispanic representation in Navy occupations are then shown by aptitude group and occupational category. This is followed by a brief examination of minority participation in the Navy's petty officer paygrades from 1982 through 1990. The results of the study reveal that the disproportionate representation of minorities in Navy ratings persists even when aptitude is controlled, suggesting the importance of factors unrelated to aptitude in determining representation. The thesis concludes with a discussion of the strengths and weaknesses of the methodology used to measure the influence of aptitude scores on minority representation in Navy ratings.

THE USE OF INTERNATIONAL STANDARDS ORGANIZATION ISO 9000 QUALITY STANDARDS IN PLACE OF MILITARY STANDARDS

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The implementation of quality standards within the European Community by the creation of International Quality Standards 9000 is another step toward development of a global marketplace. It is in the interests of DoD to support this trend in order to help maintain the defense industrial base. The first part of this study performs a comparison of DoD quality standards to the ISO 9000 Standards. The second part of the study consists of a survey of U.S. firms that have become ISO 9000 registered. This survey is intended to provide an assessment of the current movement within the defense industrial base toward adoption of ISO 9000 Standards. The survey also attempts to identify potential implementation issues relating to adoption of ISO 9000 Standards in place of military standards. It is concluded that DoD should implement ISO 9000 and that the impact of this implementation will be favorable.

INITIAL BILLET ASSIGNMENTS AND THE PERFORMANCE OF NAVAL OFFICERS

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This thesis attempts to determine if there is a relationship between initial ship type, initial billet assignment, the number of surface qualifications earned and career progress for surface warfare officers. The data used in this thesis were taken from the Officer Master-Loss Record File maintained at the Department of Defense Manpower Data Center, Monterey, California and the Officer Promotion History Data Files collected by the Department of Navy for all officers, both active and reserve duty. Information was examined for surface warfare officers whose records appeared before Lieutenant Commander selection boards as extracted from both sets of files, on both those who stayed on active duty and those who left. The Officer Master-Loss Record File was derived for those officers who were commissioned between 1 January 1976 and 31 December 1982. The Officer Promotion History Data Files (Background and Experience files) were archived beginning 1981 through 1986 for applicable surface warfare officers.

SIMULATED NEGOTIATIONS: A MEASURE OF THEIR EFFECTIVENESS ON NEGOTIATED OUTCOME

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This research sought to determine what, if any, effect the buyer's engaging in preparatory simulated negotiation has on the negotiation outcome. If it were found that the buyer's engaging in preparatory simulated negotiation resulted in a significantly improved negotiation outcome during the actual negotiation, then the conduct of such preparatory simulated negotiation in DoD could enhance negotiator effectiveness. Toward making this determination, 139 negotiations involving students, Government, and industry participants were conducted at three schools, four DoD activities and four defense contractors' facilities. The data collected from these negotiations included not only the prices negotiated, but also a qualitative assessment based on the respondents' answers to questionnaires. These data were then processed and analyzed using established statistical methods. Based on these analyses, it was concluded that buyers engaging in preparatory mock negotiation improved the negotiation outcome.

ANALYSIS OF MANAGEMENT TRAINING FOR NAVEL AVIONICS CENTER

Dale Douglas Berg-Captain, United States Marine Corps
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Master of Science in Management-December 1991
Advisor: Alice M. Crawford-Department of Administrative Sciences

This thesis addresses the benefits that the employees of the Naval Avionics Center (NAC) believe they are receiving from management training. Specifically, this study determines whether or not the management training that is offered by NAC to their scientists and engineers is perceived as beneficial. In order to determine the perceptions of the trainees, a questionnaire was developed and distributed to all eligible employees. Fifty-nine percent of the participants responded. The results of the research indicated that the trainees generally had positive responses to all of the survey questions. Based on those results, it is concluded that the scientists and engineers do perceive the training that they are receiving as beneficial. However, due to the small number of surveys returned, the results for the entire study must be considered exploratory.

SAFETY IN PETROLEUM MOVEMENT: IS ENOUGH BEING DONE TO PROTECT THE ENVIRONMENT?

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Master of Science In Management-December 1991
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This thesis is an investigation to identify whether sufficient efforts are being taken to provide the highest possible safety in petroleum movement. Current practices and ongoing initiatives for spill prevention and cleanup are identified. From these efforts, overall trends in spills have been identified. The small percentage of oil spilled, compared to the amount transferred is examined; in addition, long-term impact on the environment is analyzed. It is concluded that oil spills are inevitable no matter how much effort is exerted; they are a part of petroleum movements. However, due to the concerted efforts by industry and government, spills should continue to decline via better prevention, and those spills that do occur will be cleaned up more promptly, with less environmental impact. The author recommends that efforts for oil spill reduction need to continue and require constant management attention. In addition, specific recommendations for the oil spill program are also included.

A PC-BASED MODEL FOR ESTIMATING REGIONAL RECRUIT MARKETS

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Master of Science in Management-September 1992
Advisor: George W. Thomas-Department of Administrative Sciences

This thesis develops a personal-computer-based (PC-based) model to utilize research results for the estimation of male high quality (HQ) and high-tech (HITEC) qualified military available (QMA) population. HQ QMA are 17-21 year-old high school graduates scoring above the 50th percentile on the Armed Forces Qualification Test (AFQT). HITEC QMA are the HQ QMA who are mentally eligible for highly technical military occupations. Research underlying the PC-based model estimates multinomial logistic regression equations using the National Longitudinal Survey of Youth Labor Force Behavior (NLSY) data over a set of explanatory variables for which data are available at the county level. Using the PC-based model, nationwide county-level measures of regional male recruit markets by size and mental quality for 1990 through 2010 are estimated. The PC-based model and the nationwide market estimates may be useful in recruiting management decisions such as resource allocation and recruiter goaling.

MASS TRANSPORTATION FOR NPS: A FINANCIAL FEASIBILITY STUDY

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Master of Science in Management-June 1992
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This thesis examines the financial feasibility of a shuttle bus for the Naval Postgraduate School (NPS) located in Monterey, California. The current transit system between the student housing area, La Mesa Village (LMV), and the campus loses money and is now on the verge of cancellation. Research was primarily conducted by survey of the LMV students and compilation of the bus historical ridership/cost sheets. Secondary sources were used to gain insight into civilian intracity transit practices to determine possible shortfalls in the NPS bus service. Also, applicable state and federal environmental regulations were reviewed. The NPS bus service was found to be financially feasible, though only when NPS enlisted service members are designated as drivers. This is because cash expenditures are not required for their services. All other labor alternatives result in deficits which would require the bus service to be subsidized similar to all intracity bus operations. A reduced fare and increased schedule were shown to enhance revenues.

A DICTIONARY OF ACQUISITION AND CONTRACTING TERMS

Mark A. Brown-Lieutenant Commander, Supply Corps, United States Navy
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Master of Science in Management-June 1992
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This thesis is a continuation of research initiated by Lieutenant Commander Daniel F. Ryan, Supply Corps, United States Navy to establish a basis for defining words and terms used in the field of contracting. Concurrent research in this area is being conducted by students at the Naval Postgraduate School, Monterey, California and the Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. Published definitions of twenty-five terms presently used in Government contracting were reviewed and a synthesized definition was developed for each term. The synthesized definitions were then scrutinized by a selected group of contracting professionals. Their feedback was used to develop a revised definition based upon consensus.

THE COSTS/BENEFITS OF OPENING A SKILLED NURSING FACILITY AT NAVAL HOSPITAL, SAN DIEGO

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The objective of this study was to determine whether it would be cost-beneficial for Naval Hospital, San Diego to open a skilled nursing facility. Subsidiary purposes of the study were: (1) to determine if there is a need for skilled nursing care, (2) calculate the manpower requirements to staff a skilled nursing facility, (3) ascertain the cost to operate a skilled nursing facility, and (4) determine facility requirements. Based on the findings of this study, the following recommendations have been made: (1) open a 37-bed skilled nursing unit at Naval Hospital, San Diego as a means to reduce acute care costs, and (2) utilize the skilled nursing unit at Naval Hospital, San Diego as a pilot program to evaluate the potential for implementation of skilled nursing care at other Naval health care facilities. Analysis of financial data from civilian hospital-based skilled nursing facilities in San Diego County indicates that utilization of a 37-bed skilled nursing unit at Naval Hospital, San Diego would yield potential savings of $1,647,231 (1991 dollars) in patient care. These cost savings are made possible through utilization of smaller employee-to-patient ratios and less expensive staffing.

ANALYSIS OF BANK CREDIT CARD CONTRACTING AT NAVY FIELD CONTRACTING ACTIVITIES

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Master of Science in Management-December 1991
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This research reviews the use of bank credit cards as a small purchase method in the Navy field contracting system. The paper reviews the use of the bank credit card at Naval Weapons Center China Lake, California, Naval Ordnance Station, Indian Head, Maryland, Naval Postgraduate School, Monterey, California, and Marine Corps Base Camp Lejeune, North Carolina. The focus of the evaluation is an assessment of how successful the existing bank credit card programs are at the four sites, and the advisability of expanding the program to other field contracting activities. The study also identifies barriers and possible difficulties that would be encountered if the credit card program were to be expanded to other field contracting activities. The paper examines the existing management controls in place for the program, and makes recommendations to the Naval Supply Systems Command regarding expansion (further implementation) of the credit card program to other field contracting activities.

IMPROVING TRAINING COST INFORMATION AT THE NAVAL AVIONICS CENTER

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Master of Science in Management-December 1991
Advisors: Kenneth J. Euske & Alice Crawford-Department of Administrative Sciences

This thesis examines training cost accounting at the Naval Avionics Center, Indianapolis, Indiana. Suggestions to improve the existing training cost accounting system are proposed. Proposed solutions utilize existing computer systems, relational data base software and training software. Computer scientists, the Comptroller Department, and Personnel Department personnel would be key in implementing suggested changes. Division managers and senior would be the primary beneficiary of improved training cost information.

PRELIMINARY ANALYSIS OF THE J-52 AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM

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Increasing budgetary constraints have required program managers within the Naval Air Systems Command to justify their programs as never before. This thesis presents a preliminary analysis of the J-52 aircraft engine Component Improvement Program (CIP). The objectives of the research were to scrutinize the association of the CIP with promised improvements and benefits pertaining to the J-52 engine and to determine the obstacles that existing data bases present when an attempt is made to calculate the success or failure of a component modification. A history of the J-52 engine is provided along with a broad look at various engine performance parameter trends for the period form 1984-1990. Ten Engineering Change Proposals (ECP's) are then examined. Analysis shows that while only one of the ten ECP related fixes can be directly correlated to a tangible increase in engine performance, the overall trends have been promising with regard to improving engine maintainability, reliability and safety related factors.

COST/BENEFIT ANALYSIS OF COMMANDER, NAVAL SURFACE FORCE, U.S. PACIFIC FLEET's, SUPPLY MAINTENANCE TRAINING TEAM

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Master of Science in Management-December 1991
and
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B.S., United States Naval Academy, 1985
Master of Science In Management-December 1991
Advisor: Paul M. Carrick-Department of Administrative Sciences

This thesis is an attempt to accomplish a cost/benefit analysis of Commander, Naval Surface Force, U.S. Pacific Fleet's (COMNAVSURFPAC's) Supply Maintenance Training Team (SMTT). The effectiveness of the SMTT program is also evaluated. Data were gathered from surveys of current and former Supply Officers of COMNAVSURFPAC ships, with the Shipboard Non-Tactical Automated Data Processing II system installed and which had received all or part of an SMTT assistance visit. Interviews were conducted with selected Navy and civilian contractor members of the SMTT staff. Data were also gathered from various records and reports maintained by the SMTT staff and by COMNAVSURFPAC's Supply Assistance Center. The nature of the cost and benefit data of the SMTT program did not lend itself to a homogenous comparison of costs to benefits. The authors have determined that an attempt to "homogenize" the data with the use of economic "shadow prices" was of little value in meeting the "measurable performance" criteria of the cost/benefit analysis. Therefore, in strict terms, a cost/effectiveness analysis was accomplished. The analysis indicated that the SMTT program has resulted in positive gains in afloat supply operations. Many intangible benefits are derived from the assistance visits and there are indications of tangible benefits in the form of dollar and manhour savings. The trend of the data shows a valuable program to the fleet. Although not definitive due to data limitations, the analysis indicates a high probability that the benefits of operations of the different SMTT components exceed the costs in varying degrees.

"BEST VALUE" CONTRACTING IN THE PROCUREMENT OF ENGINEERING AND TECHNICAL SERVICES

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B.A., Ohio State University, 1981
Master of Science in Management-December 1991
Advisor: Rodney F. Matsushima-Department of Administrative Sciences

The purpose of this research is to define and discuss the "best value" concept and how it relates to the procurement of engineering and technical services. The research was conducted by a review of regulations and policy guidance, interviews with Government and defense industry personnel, and visits to Navy Contracting Activities that procure engineering and technical services. The intent of the study was to analyze how the "best value" concept is currently implemented, problems with implementation, and to offer recommendations to improve "best value" source selection. This study also recommends areas for future study that may further improve the use of "best value" in the procurement of professional services.

JUST-IN-TIME CONTRACTING IN THE DEPARTMENT OF DEFENSE

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Advisor: David V. Lamm-Department of Administrative Sciences

Just-In-Time is a production process that has revolutionized the automobile, as well as many other industries over the past forty years. The major issue in this thesis is: "What is the potential impact of implementing Just-In-Time practices into the contracting process in the Department of Defense?" The thesis focuses on the production process of the T56 engine that is reworked at the Naval Aviation Depot Facility at Alameda, California. The objective is to determine the feasibility of implementing Just-In-Time contracting practices in the procurement of selected parts for the T56 engine. The intent is to determine if utilizing this process will reduce the inventory costs and improve the quality of parts received from Department of Defense contractors. The Just-In-Time process provides a more efficient method of doing business by eliminating waste in the production process. The Department of Defense can experience significant benefits from implementing Just-In-Time practices and should pursue the implementation of this process.

THE PERFORMANCE OF NAVAL RESERVE OFFICERS TRAINING CORPS GRADUATES AT THE SURFACE WARFARE OFFICERS SCHOOL DIVISION OFFICER COURSE

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Master of Science in Management-September 1992
Advisors: Alice M. Crawford & Steven Mehay-Department of Administrative Sciences

Department of Defense budget cuts and force reductions have created the need to maximize the efficiency of the Naval Reserve Officers Training Corps (NROTC) program. This thesis addresses one dimension of NROTC productivity by analyzing the performance of program graduates at one of the Navy's post-accession schools. Specifically, this study evaluates the performance of NROTC graduates using data obtained from the Surface Warfare Officers School Division Officer Course (SWOSDOC) located in Coronado, California. Based on the results of this study, the performance of NROTC graduates at SWOSDOC is higher than it has ever been. The performance of SWOSDOC classes as a whole is higher than in the past as indicated by higher overall GPAs and very low attrition and setback rates.

STOCK FUND ASPECTS OF DEFENSE BUSINESS OPERATIONS FUND

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Master of Science in Management-September 1992
Advisor: Jerry L. McCaffery-Department of Administrative Sciences

The purpose of this thesis is to provide the essential facts about the Navy Stock Fund (NSF) portion of the Supply Management business area of the Defense Business Operations Fund (hereafter referred to as Navy DBOF (Supply)) that newly reporting financial managers and comptrollers will need, in order to maintain accountability as well as run an efficient operation. Portions of this thesis will be used in the manual for the Navy Practical Comptrollership Course. This thesis discusses specific problem areas associated with the administration and management of the Navy DBOF (Supply). It provides an overview of the evolution of the NSF to its incorporation into the Defense Business Operations Fund (DBOF). Additionally, recommendations are made to ensure that the Navy PCC continues to provide the most current information available on this topic.

ESTIMATING HIGH TECH ARMY RECRUITING MARKETS

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Master of Science in Management-September 1992
Advisor: George W. Thomas-Department of Administrative Sciences

This thesis presents exploratory model-building for identifying and analyzing the recruiting market for highly technical occupations for the Army of the future. The "high-tech" ratings were defined based upon their technical characteristics, qualification rates of the youth labor market, and the Army force structure. Using data from the National Longitudinal Survey of Youth (NLSY), three regression equations were developed to estimate mental eligibility for high-tech ratings as well as interest in joining the military and actual joining behavior, so that recruiting commands can allocate recruiting resources more accurately and efficiently. These prototypical equations and this method of measuring the recruiting market for high-tech ratings provide a good beginning for estimating the recruiting market for any specific occupation.

THE DESIGN OF A PROTOTYPE PERSONAL COMPUTER DATABASE FOR THE EXPERT SYSTEM ADVISOR FOR AIRCRAFT MAINTENANCE SCHEDULING (ESAAMS)

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Master of Science in Information Systems-December 1991
and
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Master of Science in Management-March 1992
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The Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS) was originally proposed in 1985 to assist in the scheduling of maintenance discrepancy repair in the organizational squadron environment. This dynamic environment produces a continuous flow of maintenance documentation from each maintenance action. Presently there exists no single system for the maintenance expert to retrieve this information to assist him, or her, in the critical maintenance decision making process. This thesis addresses the design of the ESAAMS database which is of paramount importance to the expert system. Research on the use of the Naval Aviation Logistics Data Analysis (NALDA) database for a personal computer-based database, is documented. Review of other existing naval aviation database systems are included in this research. Based on interviews with experienced fleet aviation maintenance managers, a prototype database design is produced. This thesis concludes with recommendations for further study based upon the findings of this research.

ENHANCING THE PHYSICAL FITNESS IN THE MARINE CORPS

Thomas Neil Collins-Captain, United States Marine Corps
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Master of Science in Management-December 1991
Advisor: Russel H.S. Stolfi-Department of National Security Affairs

Empirical tests have demonstrated a direct correlation between physical fitness and performance during sustained military operations. Physical fitness is probably the single most important factor for the individual Marine. Currently, the Marine Corps does not promote a "holistic" approach to physical fitness that accentuates the development of a Marine's strength, anaerobic and aerobic power. The objective of this thesis is to present how physical training in the Marine Corps is presently conducted and show how it can be enhanced. The focal point of a quality fitness program is the base fitness center, and although the Marine Corps concurs that fitness is a key ingredient to combat readiness, it chooses to operate the fitness centers as a recreational asset. This thesis identifies fitness centers (gyms) as the core for implementing an aggressive fitness program within the Marine Corps and argues that they should run as operational entities and completely financed with appropriated funds.

ANALYSIS OF NISTARS SMALL PARCEL SHIPPING POLICY

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Master of Science in Management-March 1992
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NSC San Diego stocks material and spare parts essential to support both the support activities and the operating forces. To fulfill this responsibility, NSC San Diego employs various shipping methodologies to get the required materials to customers, and it attempts to do this at the lowest possible cost. This thesis focuses on the small parcel shipping policy that governs the determination of the mode of shipment. The shipping factors analyzed are the small parcel package routing policy, the interface of NAVADS and NISTARS in mode-of-shipment determination, and the cost savings that have occurred by manually overriding the NAVADS recommendation.

ANALYSIS OF CONSOLIDATION OF INTERMEDIATE LEVEL MAINTENANCE FOR ATLANTIC FLEET T700-GE-401 ENGINES

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Master of Science in Management-June, 1992
Advisors: Keebom Kang & Don Barr-Department of Administrative Sciences

This thesis is an analysis of consolidation of duplicate capabilities for intermediate level maintenance of T700-GE-401 engines belonging to Naval Air Force, Atlantic Fleet. The down-sizing of the military in the next decade and the resulting budget constrained reality will force the Navy to adopt innovative measures to save costs. One of the methods by which costs can be reduced is by combining the maintenance functions of activities with duplicated capabilities into one facility, as is proposed for the maintenance facilities for this engine. To test the feasibility of the consolidation concept, the thesis uses simulation to model an Aircraft Intermediate Maintenance Department (AIMD) operating as a consolidated T700 maintenance facility under a worst-case scenario. Based on the simulation results, the thesis concludes that the proposed consolidation is a viable concept. The thesis also uses life cycle cost analysis to quantify some of the cost savings resulting from the consolidation. Specific recommendations are then made regarding implementation of the consolidation concept.

GOVERNMENT CONTRACTING UNDER THE JAVIT-WAGNER-O'DAY ACT

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B.S., Syracuse University, 1977
Master of Science in Management-December 1991
Advisor: Rodney F. Matsushima-Department of Administrative Sciences

With the passage of the Javits-Wagner-O'Day (JWOD) Act in June of 1971, the United States Congress directed Government agencies, including the Department of Defense, to procure designated commodities and services from nonprofit agencies sponsored by the National Industries for the Blind and NISH. This study provides the reader with an overview of the entire JWOD Program. It analyzes the Program's governing regulations, its intent, its oversight organizations, and the barriers and benefits to its effectual implementation. In addition, this study describes a successful example of innovative contracting by the Department of the Navy with a state-of-the-art nonprofit participant.

A DICTIONARY OF ACQUISITION AND CONTRACTING TERMS

Jon Francis Cotters-Lieutenant, United States Navy
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Master of Science in Management-December 1991
Advisor: David V. Lamm-Department of Administrative Sciences

This thesis is a continuation of research initiated by Lieutenant Commander Daniel F. Ryan, Supply Corps, United States Navy to establish a basis for defining words and terms used in the field of contracting. The 20 terms defined in this thesis were selected from a master list of contracting/procurement terms compiled by previous researchers. The methodology used to reach a consensus definition was to: (1) synthesize a definition from current published sources, (2) validate these definitions through an opinion survey of a selected group of contracting professionals, and (3) finalize definitions based on a consensus from all sources. Students at the Naval Postgraduate School, Monterey, California and Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio are conducting concurrent research on this topic.

THE BENEFITS AND INHIBITORS TO THE USE OF COMMERCIAL ITEM DESCRIPTIONS AT LOGISTICS AGENCY SUPPLY CENTERS

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The implementation of the commercial item description (CID) program is one of DoD's attempts to improve the acquisition of commercial and commercial-type products. CIDs provide the Contracting Officer with a means to solicit for commercial products using a generic description consisting of salient characteristics of products available in the marketplace. This thesis addresses the benefits and inhibitors to the use of CIDs at Defense Logistics Agency (DLA) Supply Centers. Data were collected from DLA employees and Government contractors to determine the perceived benefits and inhibitors. Based on this research, it is recommended that the parameters for the use of CIDs be expanded and continued education of the acquisition workforce regarding the CID program be held.

COST AND SCHEDULE CONTROL MANAGEMENT: WHAT THE DEPARTMENT OF DEFENSE MAJOR ACQUISITION SYSTEM PROGRAM MANAGER NEEDS TO KNOW

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In view of the current fiscal environment, marked by severe constraint and rapidly declining defense dollars, the Office of the Secretary of Defense has launched an effort to bring about better programmatic cost and schedule control for major defense acquisition programs. Thus, it is imperative for the DoD major system program manager to achieve a thorough understanding of cost and schedule control management and apply these principles to management decision making. This thesis will focus on what the DoD major system program manager should understand to accomplish this, by familiarizing the reader with the Cost Performance Report, its implementation, and report analysis. The thesis will also examine "lessons learned" as a result of the Navy A-12 Avenger termination and will discuss recent Office of the Secretary of Defense and Military Service initiatives to improve cost and schedule management. Finally, this thesis will provide the researcher's recommendations for future cost and schedule management improvement.

WHAT THE DEPARTMENT OF DEFENSE NON-MAJOR ACQUISITION PROJECT MANAGER SHOULD KNOW ABOUT COST AND SCHEDULE MANAGEMENT

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In view of a shrinking defense budget, there will likely be an increase in the number of Cost/Schedule Status Report (C/SSR) managed contracts. Thus, it is imperative that the DoD non-major system project manager understand how to integrate performance measurement information and analysis into responsible management decision making. This thesis will focus on what the DoD non-major system project manager should know to accomplish this by providing a comprehensive look at the Cost/Schedule Status Report, its implementation, and report analysis. The thesis will also discuss the Navy A-12 Avenger Aircraft Program termination affect on the C/SSR environment by presenting and analyzing recent initiatives taken to improve performance management, discussing "lessons learned," and providing the researcher's recommendations for future initiatives. Finally, this thesis will analyze proposed C/SSR Joint Guide revisions and provide recommendations for C/SSR improvement.

THE ECONOMIC IMPACTS OF MILITARY INSTALLATIONS ON REGIONAL ECONOMIES

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This thesis determined that a model could be developed to forecast the impact of the closure or restructure of a military installation on a regional economy. The closure of a military base can have a significant effect on a community, and the impacts are required by the National Environmental Protection Act to be estimated before legislative action can be passed. The research examined the theories of economic impact and multiplier effects. The principles of shift share analysis were further investigated and applied to the industries of the national and Monterey County economies. An average employment multiplier was derived and used in the development of an alternate economic impact forecast model. The research also applied other commercially available economic impact forecast models to the data associated with the base closure at Fort Ord, California, and the forecasts agreed that the county economy would suffer considerably in the short term. The selected model was then applied to two redevelopment options and the results predicted that the county economy would improve greatly in the long term after the initial slump.

THE V-22: CAN THE NATION AFFORD TO FORGO ITS PRODUCTION

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The V-22 was designed from the ground up to satisfy missions required by all military services. It is an airplane that represents the leading edge of tiltrotor technology. Since Secretary Cheney's decision to cancel the V-22 in 1989, lines of political competition have been drawn. Continued support for the V-22 comes from an influential group within Congress determined to advance the program based on its civil application. The V-22 no longer represents a purely programmatic issue. It now represents a battle between the Executive and Legislative branches over their specific defense responsibilities. This thesis addresses two primary research questions. First, using the V-22 as a case example, what are the programmatic and financial implications for the Department of Defense and industry of dual-use technology? Second, what does the V-22 teach us about the process of defense budgeting? Throughout the thesis emphasis is placed on the actions of the committees of Congress responsible for the defense budget, and specifically the V-22. This thesis examines the roles and relationships between the "players" throughout the history of the V-22 program to determine if any useful analogies may be identified with respect to present and future defense budgeting and acquisition practices.

EVALUATION OF THE COST EFFECTIVENESS ANALYSIS MODEL BEING DEVELOPED FOR THE COMPONENT IMPROVEMENT PROGRAMS OF THE AIR FORCE AND THE NAVY

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This thesis examines the Cost Effectiveness Analysis (CEA) model used by the Air Force to assist with the decision making process of their Component Improvement Program (CIP). The emphasis was on studying the model for its use in the Naval Component Improvement Program. With an example provided by General Electric, a sensitivity analysis was performed to determine the cost drivers of the model. For the example, the major cost drivers were found to be Incorporation Style, Kit Hardware Cost, and the Spare Part Factor. Next a simple simulation was conducted to determine how random component failures effect the life cycle cost variability of the CEA model. The author concluded that additional simulation studies should be conducted for other causes of variation. A detailed analysis of the model formulas and assumptions are needed as part of a users' manual.

A PROCEDURE FOR AN AFS TO PASS UNFILLED AIRCRAFT CARRIER FILL REQUISITIONS TO A NAVY SUPPLY CENTER

William Scott Curry-Lieutenant Commander, United States Navy
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M.S., Indiana State University, 1974
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Advisor: Thomas P. Moore-Department of Administrative Sciences

Presently, aircraft carrier on deployment request Fleet Issue Load List (FILL) material from supporting AFS ships on a "Fill or Kill" basis. If the material is available on the AFS, it is issued and delivered to the aircraft carrier during the next underway replenishment (UNREP). If the requested material is not-in-stock (NIS) the requisition is cancelled by the AFS. The aircraft carrier is notified of requisition cancellations during the underway replenishment. The aircraft carrier then cancels the outstanding requisition on its own inventory system, and reorders the material at the next scheduled underway replenishment or from an appropriate Naval Supply Center. This thesis suggests a procedure for an AFS to automatically forward cancelled aircraft carrier requisitions for Fleet Issue Load List material to a Navy Supply Center. During the study information was obtained from several on-site visits to an AFS and an in-depth review of current guidelines and procedures for AFS supply support and aircraft carrier requisitioning procedures. The procedure developed provides the AFS with a method for passing aircraft carrier requisitions for not-in-stock Fleet Issue Load List material, reducing requisition lead-time and aircraft carrier administrative work-load. Additional research is required to evaluate specific implementation problems and actual cost savings.

AN APPRAISAL OF COST-EFFECTIVENESS MODELS USED IN THE AIR FORCE AND NAVY AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAMS

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Master of Science in Management-December 1991
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This thesis examines the cost-effectiveness models used by the Air Force and Navy to assist with the decision-making process of their Component Improvement Programs (CIP). The focus of the research was to examine the elements of the two models and determine the reasonableness of each model's results. A sensitivity analysis was performed on significant input parameters to determine what effect errors to these parameters would have on the predicted return-on-investment (ROI) results. The author concluded that although the models provide insight into the life cycle costs (LCC) of aircraft engines, they are extremely sensitive to errors in certain input variables and should not be relied upon for CIP budget justification.

SURFACE SHIP MAINTENANCE PLANNING PROCESS

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An effective and efficient surface ship maintenance management policy and program has long been the goal of Navy planners. There currently exist several programs to assist in the planning and execution of surface ship maintenance and modernization availabilities, all supposedly in support of accomplishing repairs at the lowest required level and least cost. The key to a well maintained fleet is a well planned and properly executed maintenance and modernization program. The final product of all the planning, assessing and inspecting required prior to the start of availability is the Ship Alteration and Repair Package (SARP). The SARP is the compilation of all work assigned for accomplishment during an availability. The package is compiled by Planning for Engineering and Alterations (PERA) from the Current Ship's Maintenance Project (CSMP) and authorized SHIPALTs and approved by the Type Commander. This thesis examines the various resources available to the ship's Commanding Officer and the Type Commander to help plan and manage work definition and work package development and identifies some problems in current implementation of the process.

PRODUCTIVITY IMPROVEMENT OPPORTUNITIES AT NAVY PUBLIC ACTIVITIES

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The study identifies six principal opportunities for productivity improvement at Navy Public Works in-house maintenance activities: improving work assignment, increasing shop supervisor effectiveness, reducing long lunches and early quits (through understanding of work impediments as demotivational contributors), improving service order management, improving job order quality and miscellaneous opportunities. Activity "productivity opportunity" self-evaluation questions and methods are provided for each. Opportunities for productivity improvement are developed from a review of twenty-six completed Public Works productivity studies. Contributors to poor productivity are summarized and cross-referenced to their corresponding effects on the craft-person's time. Intrinsic task motivational theory is used to explain the widespread problem of craft-person returns for lunch to the shop. Key actions and results at specific Navy Public Works activities having documented productivity improvement are summarized.

TURKEY'S SECURITY POLICY AND NATO

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Advisor: Roger D. Evered-Department of Administrative Sciences

This research provides a study about the changing interaction of a Treaty Organization with one of its members. It describes how a member (Turkey) of the organization (NATO) rethinks its relationship with the security alliance so as to adapt to its new environment and make the necessary adjustments in its strategy. It discusses a current issue in the context of strategic management. In order to make the appropriate adjustments, past and present threats, opportunities, advantages and disadvantages are identified. The principles of strategy formulation (internal and external assessments) and evaluation (consistency, consonance, advantage, feasibility) are utilized in this analysis. Finally, the future prospects for Turkey's security policy and NATO are discussed.

A STRATEGIC PLANNING PROCESS FOR NATO FOR THE 1990s

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This thesis deals with the possible shifts in NATO's strategy for the rest of the 1990s. It uses a strategic planning model to explore these possible shifts in strategy. Strategic planning is a systematic process of defining the mission and the objectives and creating action plans, policies and resource allocations to achieve them. Every organization should initiate strategic planning in order to address the evolving needs of its stakeholders. NATO, which was founded as an organization in 1949, has to do the same thing. The general mission of NATO was to protect the freedom and the well-being of its member people. During the period of 1949-1989 NATO faced a massive Soviet threat and so defined objectives and formulated strategies to contain it. NATO's environment has radically changed since 1989. Although the general mission of NATO has not changed, it needs to identify new objectives and formulate new strategies in order to cope with the current and potential threats, and to exploit these opportunities afforded by the new environmental shifts.

SURFACE WARFARE OFFICER MANPOWER UTILIZATION: INTRODUCTION OF PERSON-JOB MATCHING ON THE ASSIGNMENT PROCESS

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B.S., United States Merchant Marine Academy, 1986
Master of Science in Management-December 1991
Advisors: Frank J. Barrett & Benjamin J. Roberts-Department of Administrative Sciences

This thesis introduces the concept of Simplified Person-Job Matching (SPJM) as a means of measuring the effectiveness of Surface Warfare Department Head Officer Distribution and Assignment process. Data base analysis of a cohort of officers attending the Surface Warfare Officer Department Head School, their career histories and prospective assignments was performed. Cohort Analysis indicate that: (1) on the average, the current distribution and assignment process is doing a marginally adequate job of matching personnel to available billets, (2) process improvement is recommended in that, 17 of the 135 officers had prospective assignments to billets that they held no prior experiences for, (3) SPJM analysis resulted in a 22% improvement for SPJM fit and resulted in no assignment of officer to billet without some related experience. Recommendations include: (1) implementation of consistent personnel policy in relation to assignment and distribution process, (2) provide budgetary funding for next generation Officer Assignment and Information System (OAIS) computer software, (3) incorporate computer program to ensure SPJM is accomplished, (4) utilize future software improvements to merge the somewhat adversarial roles of Assignment and Placement officers.

COST ESTIMATION OF SOFTWARE DEVELOPMENT AND THE IMPLICATIONS FOR THE PROGRAM MANAGER

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Cost estimation of computer software development is a critical problem for the Department of Defense. The acquisition of major weapons or hardware has been impacted by cost overruns and schedule slippage in software development. Program Managers are responsible for estimating a program's cost using the information provided by the contractor and the cost analysis divisions within the System Commands. This study first analyzes why variance exists between the different estimates for the same software project that are provided to the Program Manager as input to the budget estimate. The study then examines four methods that are used to understand and reduce the variance between the estimates to give the Program Manager more control over the software development cost estimation process. A set of five specific decision rules is developed for the Program Manager to implement in the cost estimation process. The intent of the study is to improve the accuracy of the cost estimate by reducing variance between the independently generated estimate submitted to the Program Manager.

A PRELIMINARY SIMULATION MODEL FOR THE ADVANCED TRACEABILITY AND CONTROL (ATAC) SYSTEM

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and
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B.A., University of California, Los Angeles, 1975
Master of Science in Management-December 1991
Advisors: Alan W. McMasters & Thomas P. Moore-Department of Administrative Sciences

The purpose of this thesis was to develop a preliminary simulation model of the Advanced Traceability and Control (ATAC) process. The motivation was the need to evaluate significant policy decisions such as, Defense Management Review Decision (DMRD) 901's "ship or hold" decision. An analysis of the operation of ATAC and the data base maintained by Navy Material Transportation Office (NAVMTO) were made to provide necessary details for constructing the model. Significant data base problems were discovered that precluded the development of an elaborate simulation model. Although the simulation model is very simple, it does show that more detailed and accurate ATAC data are needed to effectively measure and monitor the ATAC system.

AN EVALUATION OF THE 1989 RESTRUCTURING OF THE NAVY MEDICAL DEPARTMENT FROM THE PERSPECTIVE OF FINANCIAL MANAGERS

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This thesis examines the perceptions of personnel of the Navy Medical Department regarding the organizational restructuring which took place in 1989. Included in the thesis is a background discussion of the change effort including underlying causes, the nature of the restructuring, and implementation methods. Data for the thesis came from reference reviews, personal interviews with key players, and a survey questionnaire. The target population for the survey questionnaire was the financial management professionals within the Medical Department. The change effort is evaluated utilizing models drawn from change literature and focuses on comparing planned versus perceived actual outcomes, the perceptions of effectiveness of change leadership, and the perceived current status of management indicators.

POTENTIAL IMPACT OF THE ELIMINATION OF THE M ACCOUNT ON THE DEPARTMENT OF THE NAVY

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Advisor: Richard A. Harshman-Department of Administrative Sciences

This thesis addresses the impact of Public Law 101-510, which eliminated the M Account, on financial management within the Department of the Navy. The M Account was established for the payment of prior year obligations from appropriations which had lapsed. The M Account process provides the necessary flexibility to Navy contract administrators and financial managers to manage resources related to the closure of prior year contracts. Public law 101-510 was enacted in 1990 based on Congressional concern over Department of Defense management of the M Account. This study examines this law and the impact this legislation will have on future financial decision-making in the Department of the Navy. The assessment focuses specifically on the Procurement and Operations & Maintenance appropriations for the Navy.

VOLUNTARY SEPARATION AND EARLY RETIREMENT PLANS: A SURVEY OF NAVAL POSTGRADUATE SCHOOL LIEUTENANT COMMANDERS

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Lieutenant Commanders (LCDRs) attending the Naval Postgraduate School were surveyed on their perceptions of three voluntary separation plans, Special Separation Benefit (SSB), Voluntary Separation Incentive (VSI) and 15-year early retirement. Additionally, several factors were studied to identify their relationship to the likelihood of accepting one of the plans. Survey results indicate that: 1) LCDRs are a career oriented group who plan to remain in the Navy at least until eligible for a 20-year retirement, 2) there is little probability that LCDRs would accept SSB or VSI if given the choice, 3) the majority of LCDRs (60 percent) expressed some likelihood of accepting 15-year early retirement if given the opportunity, 4) full retirement benefits and lifetime monthly income were the most important factors considered when ranking the three plans in order of their likelihood of acceptance, and 5) availability of medical care was rated as the most important benefit in their acceptance decision.

OP-12/PERS-5 IN THE MANPOWER PROCESS

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The purpose of this thesis is to analyze the operations of the Chief of Naval Personnel's Total Force Programming and Manpower Division, OP-12/PERS-5, and to document OP-12/PERS-5's functions in determining Navy manpower requirements and programming authorizations. The thesis also addresses the role OP-12/PERS-5 plays in the Congressional requirement to reduce manpower end strength. This thesis specifically discusses: (a) the methods of determining manpower requirements and programming manpower authorizations; (b) the Department of the Navy agencies that assist in manpower requirements determinations; (c) the OP-12/PERS-5 organizations; (d) the supporting data base systems; (e) the computer model that assists in manpower programming; and (f) OP-12/PERS-5's relationships with other OP-01 divisions.

AN EVALUATION OF INTERNAL CONTROL FOR A NONAPPROPRIATED FUND INSTRUMENTALITY (NAFI)

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This thesis reviews the internal controls of selected transaction cycles for a Nonappropriated Fund Instrumentality (NAFI). A review of the Government internal control requirements is followed by the review which utilized interviews, observation, and investigative techniques to gain an understanding of the internal control structure. The study includes narrative descriptions, transaction flowcharts, and internal control questionnaires for gaining full understanding of the business activities. Test of controls utilizing attribute sampling were employed to evaluate the effectiveness of the NAFI internal control structure. Analyses and recommendations are offered for improvement of the internal controls.

AN ANALYSIS OF THE GENERAL SERVICES ADMINISTRATION BOARD OF CONTRACT APPEALS BID PROTEST DECISIONS AND THE EFFECT ON AUTOMATED DATA PROCESSING EQUIPMENT/FEDERAL INFORMATION PROCESSING RESOURCES PROCUREMENTS

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This thesis studied Automated Data Processing/Federal Information Processing (ADP/FIP) protest issues brought before the General Services Administration Board of Contract Appeals (GSBCA) over a two-year period. The ADP/FIP acquisition environment and process is presented. Also, the forums for ADP/FIP protests are explored with an understanding of each forum's decision-making criteria developed. The objective of this study was to identify the issues for protest most often faced by Contracting Officers, as well as the issues that are "favored most" by the GSBCA. A mathematical model for weighting all protest issues versus Board granted protest issues was developed and used for the ranking and analysis process of this study. Case decisions are sighted as examples in support of the quantitative analysis. The thesis concludes that the solicitation and specification process is the source of most sustained protests. Further, the contracting officer's selection and evaluation process is basically sound. Finally, this thesis demonstrates the GSBCA's adherence and demand for upholding the concept of competition. The Board's penchant for competition is sometimes at the expense of other equally sound concepts such as economy and efficiency.

FINANCIAL CRITERIA USED IN CASE ADJUDICATION BY THE DIRECTORATE FOR INDUSTRIAL SECURITY CLEARANCE REVIEW (DISCR)

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An analysis of financial criteria used in case adjudication by the Directorate for Industrial Security Clearance Review (DISCR) was conducted to determine those financial factors most relevant in granting or denying security clearances to industrial personnel. It was concluded that the underlying cause of debt and subsequent handling thereof by the applicant were more influential than the type, number or dollar amount of debt in determining case outcome. Applicants whose debts were due to circumstances beyond their control and who made good faith efforts to resolve their debts were more likely to be granted clearances than applicants whose debts were due to carelessness or financial mismanagement and who made little or no attempt to resolve their debts. Ten financial factors most highly correlated with case outcome were identified and grouped in four main categories. Adjudicators were found to determine case outcomes in accordance with established adjudication policy.

DEPARTMENT OF DEFENSE FINANCIAL MANAGEMENT EDUCATION AND TRAINING PROGRAMS: A SURVEY OF QUALITY ASSURANCE METHODS

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This thesis presents and discusses the results of a survey designed to determine how Department of Defense financial management education and training programs assess the quality of their programs. Quality in the context of this thesis means providing accurate, valid, comprehensive and up-to-date information to meet the needs of clients and customers. The thesis describes the need within the Department of Defense for financial management education. It documents the methodology employed in developing the survey. The thesis discusses the general characteristics of financial management education and training programs and summarizes the methods employed to ensure the quality of these programs.

A PROFILE OF SCIENTIST AND ENGINEER TRAINING CONDUCTED BY THE NAVAL AVIONICS CENTER

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This thesis provides an assessment of the training program from the perspective of civilian scientists and engineers working at the Naval Avionics Center (NAC). This assessment can be used in conjunction with other studies to provide NAC management with a basis on which to evaluate its return on investment from training. The author used a questionnaire to survey scientists and engineers in order to reveal training related trends across departments, job categories, paygrade levels, gender, ethnic origin, age, experience at NAC, and marital status. The author concluded that there is a good organizational climate for and support of the training program at NAC, that most of the job needs of scientists and engineers are being met by NAC's training program, and that there are some administrative changes needed to improve the training program. In addition, the kinds of NAC training that are most useful to scientists and engineers are identified. The author presented several recommendations to improve the training program at NAC.

PANACEA OR PERESTROIKA: A SOCIO-ECONOMIC ANALYSIS OF THE EQUITY AND EFFICIENCY EFFECTS OF CHOICE IN EDUCATION

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This thesis looks at the equity and efficiency effects of Choice. Specifically studied is equalization effects in school finance and the "collective add-on" as proposed by John Chubb and Terry Moe in Politics, Markets, and America's Schools. Analyzed as a system, the educational sector is described as a process whereby the polity reproduces itself. Hence, the control of the sector by state, parental and social interests is considered as the system is set in motion under the Choice proposal. Operating under the principles of best and equal, or inequality and equality, the system expands until it reaches a point of diminishing marginal utility. Because equity and efficiency are difficult to achieve synonomously, the question is raised regarding whether we are underinvesting in our children and whether a common commitment to democratic citizenship should lie at the heart of what education should be about.

LEARNING OBJECTIVES FOR THE NAVY PRACTICAL COMPTROLLERSHIP COURSE: A VALIDATION

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The Navy Practical Comptrollership Course (PCC) plays a significant role in training today's Navy financial managers. This thesis examines the specific learning objectives contained in the syllabus to determine whether these objectives meet the needs of Navy financial managers. Using the responses from a survey which was distributed to Navy financial managers, this thesis seeks to validate the specific learning objectives. It is concluded that the specific learning objectives are, for the most part, valid. Some proposed changes/revisions to the learning objectives are provided as an input for the course instructor. Additionally, this thesis conducts a brief analysis of previous Navy PCC attendees concerning the allotment of class time to instructor lectures, guest speakers, case studies and discussion time between students.

TQL, A CASE STUDY OF IMPLEMENTATION TO THE OPERATIONAL FLEET

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In August of 1990, the CNO released a memorandum to all flag officers to bring Total Quality Leadership (TQL) to the operational fleet. This thesis is a case study of how an operational command goes about adopting the philosophies of TQL. Discussion of W.E. Deming's management philosophies and the Navy's Process Improvement Model are presented as backgrouond information. The case study presented is offered as a guide for implementation to the operational fleet, as all organizations or commands are unique in many respects. The development of this case and the theories of TQM/TQL have shown one overwhelming factor to be present in all successful TQM/TQL implementations: "Commitment from top management is essential for the philosophy to be successful."

THE LEGISLATIVE ROLE IN THE MILITARY ACQUISITION PROCESS

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Changing threat postures from the Soviet Union and the recent conclusion of a very lopsided war in the Middle East have citizens and policy makers critically questioning the military's composition, size and mission. A smaller military combined with significant acquisition policy changes, face the military acquisition community of the future. In order to exist within that new acquisition environment, Program Managers will have to fully understand that environment. The Program Manager will especially need to research the Congressional - DoD relationship. It is Congress who authorizes and appropriates funds for DoD acquisition programs. It is also Congress who conducts aggressive oversight of acquisition programs that can affect the PM's leadership of an acquisition program. Developing an understanding about these interactions is the PM's best strategy to prepare for their occurrence.

PHYSICAL READINESS TESTING OF SURFACE WARFARE OFFICERS

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and
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This study focused on the appropriateness of the Navy's physical readiness test (PRT), particularly as it applies to surface warfare officers (SWOs). Physical requirements of fleet SWOs were addressed through two separate surveys and an extensive literature review. Differences in fleet PRT requirements and physical requirements set forth by SWO accession sources were also examined. Further review of literature allowed for evaluation of the individual components which currently comprise the PRT, in addition to possible alternatives. Methods of body fat measurement were also presented. Finally, situations which lead to difficulties in the administration of the PRT were assessed, including deployments scoring of the PRT, medical waivers, and attitudes and perceptions of Navy members concerning the PRT. Based on information obtained in these areas, recommendations were made for changes in accession requirements, PRT components, and PRT administration.

OCCUPATIONAL TRENDS IN THE CIVILIAN AND NAVY LABOR MARKETS

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This thesis compares occupational trends in the civilian and Navy Labor Markets. This is accomplished by matching civilian occupations to Navy ratings with similar job characteristics. The matched occupations are categorized according to technical level and skill level. These categories are used to compare trends in occupational participation and earnings. The results of the analysis support the conclusion that competition for highly technical and skilled workers between the Navy and civilian work force is increasing. It is recommended that the Navy continue to emphasize highly technical and skilled occupations when allocating reenlistment bonuses. It is also recommended that further research be conducted on the inclusion of occupational variables in regression models that predict reenlistment rates.

PLANNING, PROGRAMMING AND BUDGETING (PPBS) BUDGET REVIEW AND CONGRESSIONAL ACTION

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This thesis examines the role of financial managers within the Department of the Navy with respect to the Federal budget process and the Department of Defense Planning, Programming and Budgeting System (PPBS). This study determines the most current practices used in these processes and translates the information into useable material for Department of the Navy station comptrollers and military financial managers. As such, it is intended to form the basis for a working knowledge of the complex world of federal budgeting for the newly reporting station comptroller, who in many cases has had little or no prior concern with such issues.

COST CENTER FINANCIAL MANAGEMENT: TRAINING THE OPTAR MANAGERS

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This thesis assesses the training needs of cost center personnel who perform financial management related duties. Research focused on the OPTAR managers, those who requisition supplies/services, prepare travel orders and/or maintain the cost center's memorandum accounting records. Using the mail survey research method, OPTAR managers were queried regarding demographics, job skills, and professional knowledge. Type, availability, and comprehensiveness of training received were also ascertained. Following analysis of survey data, an assessment of training was made. Due to a significant amount of turnover and a lack of prerequisite professional knowledge, it was determined that training currently available is not meeting the needs of OPTAR managers. Recommendations were made for enhanced training programs.

AN ANALYSIS OF THE STATE OF TOTAL QUALITY IN ACADEMIA

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Implementation of total quality in an academic environment requires major organizational changes predicated on a new paradigm directed at continuous process improvement. The principles of total quality can be successfully applied in academic institutions. Implementation in any organization can be a difficult process, subject to a number of risks and external constraints. Academe is not fundamentally different from industry with regard to implementation of total quality. This study identifies 126 institutions of higher education actively applying total quality. Telephone interviews were conducted with representatives of 192 post-secondary educational institutions. In depth personal interviews with representatives of nine academic institutions that are currently applying the principles of total quality to internal processes were also conducted. These contacts provided the foundations for an examination of the state of total quality in academia. Roles of leadership, implementation strategies, organizational structure, and management systems are explored. Measurement, outcomes and results of the quality effort are also investigated.

A COMPARISON OF THE SMALL AND DISADVANTAGED BUSINESS UTILIZATION SPECIALISTS (SADBUSs) ROLE AT NAVEL REGIONAL CONTRACTING CENTER (NRCC) PHILADELPHIA, PA AND NAVAL REGIONAL CONTRACTING CENTER (NRCC) SAN DIEGO, CA DETACHMENT LONG BEACH

Patrick J. Hennelly-Lieutenant Commander, Supply Corps, United States Navy
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This thesis analyzes the role of the Small and Disadvantaged Business Utilization Specialist (SADBUS) at the Naval Regional Contracting Center (NRCC) Philadelphia, Pennsylvania and at NRCC San Diego, California Detachment Long Beach, California. The focus of the research was to determine what measures need to be taken to improve the efficiency and effectiveness of these SADBU Specialists. The thesis begins with a brief review of the statutes and regulations which govern the role of the SADBUS in the Department of Defense. Through a comparative analysis of the two NRCCs, the researcher was able to reach certain conclusions about improvements which need to be made in the role of the SADBU Specialist at each NRCC. The researcher concluded that each SADBUS could be more effective in their position, if they increased the amount of market research they performed. Both SADBU Specialists also need to improve the quality of the market research they perform, to identify Small Businesses capable of performing successfully on Government procurement contracts.

MILITARY RETIREES AND THEIR PERCEIVED HEALTH CARE NEEDS

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Advisor: B. Wayne Blount-Department of Administrative Sciences

This thesis focuses on the identification of perceived health care needs among military retirees residing on the Monterey Peninsula and within the catchment area of Silas B. Hays Army Community Hospital. Military retirees are expected to be the primary users of military health care services on the Monterey Peninsula after Fort Ord closes sometime in 1994. This thesis identifies their perceived health care needs and determines how they vary demographically. By identifying their perceived health care needs, DoD officials can determine what military medical resources may need to remain in the area to meet those needs, if Silas B. Hays Army Community Hospital, also located on Fort Ord, should close.

LEARNING OBJECTIVES FOR ENTRY-LEVEL DEPARTMENT OF THE NAVY ACCOUNTING TECHNICIANS (GS-525 SERIES)

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Master of Science in Management-December 1991
Advisor: Glenn D. Eberling-Department of Administrative Sciences

Defense Management Review Decision No. 985 cited the inadequacy of existing financial management education and training, and mandated the review of current education and training offerings to identify gaps and overlaps. As such, this thesis focuses on the education and training needs of one segment of the financial/resource management community: entry-level GS-525 series accounting technicians. The objective of the thesis is to identify commonalities among the tasks performed by entry-level GS-525 series accounting technicians, holding various jobs at different types of commands. Accordingly, it identifies current and future characteristics of the GS-525 series accounting technician work force, identifies current and proposed career development plans, current instructional offerings and future training needs, and proposes specific learning objectives for incorporation into a comprehensive and continuous training program.

COSTS OF OPERATION DESERT SHIELD/DESERT STORM:
A BURDEN SHARING PERSPECTIVE
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B.S., United States Naval Academy, 1983
Master of Science in Management-December 1991
Advisors: William R. Gates & Katsuaki L. Terasawa-Department of Administrative Sciences

This thesis analyzes burden sharing issues of Operation Desert Shield/Desert Storm. Explanations of economic principles including public goods theory, disproportionality, free riding, marginalism, and opportunity cost provide a common base of knowledge necessary for an intelligent discussion of burden sharing in defense alliances. The thesis concentrates on the problems associated with quantifying benefits, costs and equity issues in multilateral force actions like Operation Desert Shield/Desert Storm. In particular, it analyzes the Persian Gulf oil supply security benefit and evaluates the efficacy of various oil benefit measures. Current cost estimates and cost reports focus on legitimizing supplemental funding. They do not capture all of the incremental costs appropriate for burden sharing. This thesis examines the critical differences between incremental burden sharing costs and the costs that were reported to satisfy Congressional budget deliberation. Recommendations focus on ways for the U.S. to implement the financial lessons learned from Operation Desert Shield/Desert Storm to be more prep for similar burden sharing arrangements in the future.

LEARNING OBJECTIVES FOR DEPARTMENT OF THE NAVY
ENTRY-LEVEL BUDGET ANALYSTS (SERIES GS-560)
Heidi H. Holfert-Lieutenant, United States Navy
B.S., Arizona State University, 1983
Master of Science in Management-December 1991
Advisor: Glenn D. Eberling-Department of Administrative Sciences

This thesis identifies learning objectives which Department of the Navy (DoN) entry-level budget analysts should learn during their first year on the job in order to perform effectively and efficiently. It provides various demographics of budget analysts, including job requirements and the types and locations of assignments. A discussion of the Department of Defense financial management environment focuses on current and future trends which are or will be impacting budget analysts. In addition, training courses and programs that are currently available to DoN entry-level budget analysts are examined. The primary conclusion of this research was that there is a dire need for quality training of DoN entry-level budget analysts. Recommendations are offered on how the learning objectives identified by this study can be utilized to assist in the development of quality training courses, materials, and programs.

NAVAL NEW SHIP CONSTRUCTION COST ANALYSIS AND TRENDS

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Master of Science in Management-June 1992
Advisor: Richard A. Harshman-Department of Administrative Sciences

This thesis presents an analyses of the Ship Construction and Conversion, Navy, Appropriation cost estimates for new ship construction during the period 1960-1992. Emphasis is placed on four specific shipbuilding programs: Guided Missile Destroyer (DDG-51), Fleet Ballistic Submarine (Trident), Attack Submarine (SSN-688), and Guided Missile Cruiser (CG-47). These programs are analyzed to determine how competition/dual sourcing, contract type and the shipbuilding marketplace have influenced the actual costs of these ships. These programs are also compared for the period 1981-1992 to determine if there are any trends of consistency for all of the programs. The research concludes that the shipbuilding marketplace has a significant influence on actual construction costs of Navy ships. When there is limited commercial work available the shipbuilders may underbid contracts to remain in business. Competition in Navy shipbuilding does not necessarily result in cost savings due to the small number of ships produced and the limited number of competitive shipyards.

AN ANALYSIS OF THE ARMY ACQUISITION CORPS

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Master of Science in Management-December 1991
Advisor: David V. Lamm-Department of Administrative Sciences

This thesis presents an analysis of the Army Acquisition Corps. The Packard Commission and the Army's Materiel Acquisition Management program were used to develop issues and questions concerning the selection, education, training, and assignment policies for Army Acquisition Corps officers. A detailed description of the Army Acquisition Corps is provided. Data are presented based on personal interviews conducted with fourteen Army program managers using the issues and questions as a standard interview script. The data are analyzed and conclusions made with reference to the structure and policies of the Army Acquisition Corps. The basic concept and structure of the Army Acquisition Corps were validated from the interview responses. Recommendations for further improvement of the Army Acquisition Corps are presented.

COST/BENEFIT ANALYSIS OF COMMANDER, NAVAL SURFACE FORCE, U.S. PACIFIC FLEET's, SUPPLY MAINTENANCE TRAINING TEAM

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Master of Science in Management-December 1991
and
Carlos D. Buzon, II-Lieutenant, Supply Corps, United States Navy
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Master of Science in Management-December 1991
Advisor: Paul M. Carrick-Department of Administrative Sciences

This thesis is an attempt to accomplish a cost/benefit analysis of Commander, Naval Surface Force, U.S. Pacific Fleet's (COMNAVSURFPAC's) Supply Maintenance Training Team (SMTT). The effectiveness of the SMTT program is also evaluated. Data were gathered from surveys of current and former Supply Officers of COMNAVSURFPAC ships, with the Shipboard Non-Tactical Automated Data Processing II system installed and which had received all or part of an SMTT assistance visit. Interviews were conducted with selected Navy and civilian contractor members of the SMTT staff. Data were also gathered from various records and reports maintained by the SMTT staff and by COMNAVSURFPAC's Supply Assistance Center. The nature of the cost and benefit data of the SMTT program did not lend itself to a homogenous comparison of costs to benefits. The authors have determined that an attempt to "homogenize" the data with the use of economic "shadow prices" was of little value in meeting the "measurable performance" criteria of the cost/benefit analysis. Therefore, in strict terms, a cost/effectiveness analysis was accomplished. The analysis indicated that the SMTT program has resulted in positive gains in afloat supply operations. Many intangible benefits are derived from the assistance visits and there are indications of tangible benefits in the form of dollar and manhour savings. The trend of the data shows a valuable program to the fleet. Although not definitive due to data limitations, the analysis indicates a high probability that the benefits of operations of the different SMTT components exceed the costs in varying degrees.

A COMPARISON OF THE FINANCIAL MANAGEMENT CURRICULUM AT THE NAVAL POSTGRADUATE SCHOOL AND OTHER GRADUATE PUBLIC FINANCIAL MANAGEMENT CURRICULA IN THE UNITED STATES

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M.S.A., Central Michigan University, 1989
Master of Science in Management-June 1992
Advisors: Larry R. Jones & Jerry L. McCaffery-Department of Administrative Sciences

This thesis provides a comparative analysis of the financial management curriculum at the Naval Postgraduate School (NPS) and other graduate public financial management curricula offered in graduate college and university programs throughout the United States. MBA curriculum data were solicited from business schools, MPA curriculum data were obtained from policy schools, and DoD components were polled for service-sponsored graduate education data. Curricular data are compared and evaluated. The thesis concludes that the financial management curriculum at NPS is a special program that includes the best of both MBA and MPA curricula. The NPS curriculum coverage is uniquely adapted to provide public sector graduate financial management education. No other program offered in the U.S. is better designed to meet the financial management education needs of the Navy and Department of Defense. It meets the requirements of the sponsor, and is a course of study that the Navy can depend on to produce financial managers to handle present and future fiscal challenges.

A PRELIMINARY SIMULATION MODEL FOR THE ADVANCED TRACEABILITY AND CONTROL (ATAC) SYSTEM

Robert Lawrence Jacobs-Lieutenant, Supply Corps, United States Navy
B.A., University of California, Los Angeles, 1975
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and
Robert Michael Dryer-Lieutenant, Supply Corps, United States Navy
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Master of Science in Management-December 1991
Advisors: Alan W. McMasters & Thomas P. Moore-Department of Administrative Sciences

The purpose of this thesis was to develop a preliminary simulation model of the Advanced Traceability and Control (ATAC) process. The motivation was the need to evaluate significant policy decisions such as, Defense Management Review Decision (DMRD) 901's "ship or hold" decision. An analysis of the operation of ATAC and the data base maintained by Navy Material Transportation Office (NAVMTO) were made to provide necessary details for constructing the model. Significant data base problems were discovered that precluded the development of an elaborate simulation model. Although the simulation model is very simple, it does show that more detailed and accurate ATAC data are needed to effectively measure and monitor the ATAC system.

COST ESTIMATES FOR DESERT SHIELD/DESERT STORM: A BUDGETARY ANALYSIS

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Operation Desert Shield/Desert Storm (DS/DS) presented unique challenges for estimating the cost of that conflict. This analysis reviews the cost estimates and methodologies developed for that purpose by DoD, CBO and GAO. It considers the budget climate and the role of foreign cash and in-kind contributions. Finally, it reviews the budgeting innovations used to provide and monitor DS/DS defense spending. At the outset of the crisis, costs were estimated to determine the defense funding requirements for DS/DS. Because of the specific provisions of the Budget Enforcement Act of 1990, these estimates focused on the incremental impact on DoD's budget. This was difficult because incremental costs were not defined and DoD's accounting structure does not measure incremental costs. As allied financial support for U.S. defense expenditures increased, cost estimates were also used to measure the relative contributions of donor countries. This led to debates over the proper definition of incremental costs. Appropriate incremental costs were collected from a budgetary viewpoint, but not from a burden sharing perspective. Comparing the DS/DS cost estimates and the foreign cash and in-kind contributions, it appears that foreign contributions will cover DoD's incremental budgetary costs, but not the total incremental costs of the war.

VIDEO TELECONFERENCING FEASIBILITY STUDY AT THE NAVAL POSTGRADUATE SCHOOL

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Master of Science in Management-June 1992
Advisors: Allan W. Tulloch & Myung W. Suh-Department of Administrative Sciences

A preliminary study was completed that measured the operational and technical feasibility of video teleconferencing (VTC) at the Naval Postgraduate School (NPS). As a part of the fact-finding effort, a VTC Round Table was convened in order to define the nature of the problems that prompted NPS to consider VTC as a possible solution. Potential opportunities for utilizing VTC to improve the quality of education offered by NPS were discussed, and various alternatives for installing a system were considered. It was concluded that the operational and technical feasibility of VTC were convincing enough to justify the continuation of VTC implementation at NPS. The economic aspects of VTC were viewed to be of secondary importance because case studies indicate that quantitative benefits such as travel displacement have been overshadowed by the qualitative gains such as increased productivity. This study recommends that NPS move ahead with its plans to implement a "full-feature" VTC system and install it in a new academic building currently under construction. Additionally, this study acknowledges the findings of the draft DoD instruction, *Teleconferencing Activities, Systems and Networks,* which endorses the use of the Federal Telecommunications System (FTS)2000 for long-haul network services. It is recommended that NPS utilize the FTS2000 Compressed Video Teleconferencing Service (CVTS) for its VTC needs, and lease the VTC equipment with an option to buy.

AN ANALYSIS OF THE IMPACT OF GRADUATE EDUCATION ON THE PERFORMANCE AND RETENTION OF GENERAL UNRESTRICTED LINE OFFICERS

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This thesis focuses on the impact of graduate education on the promotion performance and retention of General Unrestricted Line Officers. Logistic models are developed to determine the effects of a graduate degree from the Naval Postgraduate School and other sources on the probability of promotion to Lieutenant Commander and Commander, and on retention up to the Lieutenant Commander and Commander levels. Results indicate that graduate education has a positive impact on the probability of promotion to Lieutenant Commander, with Naval Postgraduate School showing a stronger effect than other education sources. No significant effect was noted for promotion to Commander. Graduate education was found to have a significantly negative impact on retention prior to the Lieutenant Commander selection point. Results for retention at the Commander selection level were inconclusive. It is recommended that further research be done concerning the impact of graduate education on other officer communities.

THE LIMITS AND POSSIBILITIES OF DECISION MODELS FOR ARMY RESEARCH AND DEVELOPMENT PROJECT SELECTION

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Master of Science in Management-March 1992
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The case is made for applying Multicriteria Decision Models (MCDM) to the Army's research and development (R&D) project selection process. Given the recent changes in the international strategic environment and the resulting Congressional emphasis on applied research short of production, the need for improved efficiency in selecting Army R&D project alternatives is increasing. R&D project selection problems are non-trivial, with many stakeholders and multiple criteria for evaluating the alternatives to meet the organization's various objectives. Research on human cognition has revealed that typical notions about decision making are inefficient for dealing with multi-criteria decision problems. MCDM such as the Analytic Hierarchy Process, Multiattribute Utility Theory, Goal Programming, and Graphical Techniques are designed to support these decisions by formulating logically supportable choices. Each of these four models is described and a summary of their strengths and weaknesses is presented.

ROLE OF THE INLAND WATERWAYS SYSTEM DURING MOBILIZATION

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This thesis examines the Department of Defense's (DoD) use of the inland waterways system during mobilization. The study furnishes a historical and present-day review of the inland waterways system. The thesis also addresses the military's current use of the inland waterways system. The emphasis of the thesis is on exploring the potential cost savings available in using inland waterway transportation for unit movements. There is potential for the military to realize sizable cost savings by moving unit equipment over the inland waterways. The paper proposes that DoD planners use Gulf coast ports as points of entry for returning equipment. These Roll-on/Roll-off (RO/RO) capable ports can provide low-cost waterborne transport when moving military units returning from overseas deployment.

AN ANALYSIS OF REENLISTMENT INTENTION AND ACTUAL REENLISTMENT OF ARMY SECOND-TERM ENLISTED PERSONNEL

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This thesis investigated an Army male second-termer's intended and actual reenlistment to identify key factors that significantly affect his decision to prolong his career in the Army using the 1985 DoD Survey of Officers and Enlisted Personnel conducted for the office of the Assistant Secretary of Defense (Force Management and Personnel). The sample was limited to those in paygrades E4-E6, with 5-10 years of service, and who had less than one year remaining in their commitment. Psychological, economic, organizational, and personal/demographic characteristics were investigated to determine their effect on the enlistees' career decision. A multivariate logit regression model was estimated utilizing these explanatory variables: Single/Wo/Dep., Single/W/Dep., Married/Wo/Dep., Black, Hispanic, YOS, Technical, Medical, Admin/Supply, Probability of Alternative, and Composite variables for satisfaction with work environment, and satisfaction with pecuniary benefits. The result indicate that there were significant differences in the factors affecting the intended and actual reenlistment decisions. Black, YOS, Medical, Probability of Alternative, Satisfaction with Work Environment, and Satisfaction with Pecuniary Benefits were significant in explaining intentions while Single/Wo/Dep., Married/Wo/Dep., YOS, Admin/Supply, and Satisfaction with Work Environment were significant in explaining actual reenlistment.

REGRESSION ANALYSIS OF DEMAND FOR U.S. MILITARY LABOR

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The past year has been one of unprecedented change for the U.S. military organization. It would be of interest to analyze the impact of changing situations on the U.S. military labor demand. In this thesis, several demand models for U.S. military labor are considered to identify influential factors on the prediction of the size of the future military labor. A stepwise regression analysis is used to select some significant demand models. Data used to construct demand models in this thesis cover the period of 1963-1986, while actual data (1987-1990) are used to check model validity. Demand models selected are used to simulate force levels through the year 2000 under various scenarios regarding predictors. Major contributions of this thesis are employing international security (war casualty), USSR's military end-strength and the past year's U.S. end-strength in the prediction models for military labor demand. The resulting demand models turn out to be more parsimonious but they have better predictabilities than the existing model. The results of simulation study based on various scenarios regarding war casualty and USSR's end-strength will provide policy makers with useful information for the future defense manpower plan.

BUDGETING FOR TEST AND EVALUATION IN THE DEPARTMENT OF THE NAVY
William Harold Kindred
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Master of Science in Management-December 1991
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This thesis examines the Department of the Navy's Research, Development, Test and Evaluation organization, mission, goals, program structure, and budget process, with particular emphasis on the weapons system test and evaluation community. It also examines the current and future DoD budget climate, to include overall Defense, DoN, RDT&E, and T&E budget projections through FY1995. The aggregate impact of Congressional budget actions, investment strategies, endstrength reductions, and Defense Management Review initiatives on budgetary planning for Navy T&E activities is described and assessed. As a result of these efforts certain conclusions are made, and general recommendations proposed for future Navy T&E planning and budgeting activities.

ANALYSIS OF P-3 AIRCREW COORDINATION TRAINING
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Master of Science in Management-September 1992
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Crew coordination error has been identified by the Naval Safety Center as the number one cause of Naval Aviation mishaps. To address the problem of crew coordination all Fleet Replacement Squadrons were directed to implement a training program for all Naval Aircraft. Patrol Squadron Thirty-One was tasked to implement crew coordination training for P-3 fleet replacement students and for fleet squadrons. A one day seminar was developed and implemented for Moffett Field and Barbers Point P-3 squadrons. To measure the effect of crew coordination training the *Cockpit Management Attitudes Questionnaire* was administered to crew members prior to and after the seminar. Based on the results of the questionnaire, attitudes that lead to effective crew coordination are enhanced by the seminar. Utilizing t-tests of before and after questionnaire responses, significant changes in attitudes for crew members were identified and explained.

ANALYSIS OF THE NAVY'S USE OF RAIL TRANSPORTATION
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Master of Science in Management-December 1991
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This thesis examines the Navy's use of railroads for shipping Navy freight over a five-year period to determine the pros and cons of current rail use and future requirements. This study revealed that there are deficiencies in historical data available to conduct a cost/benefit analysis of rail transportation and make comparisons to other modes. A quantative decision support model in the form of a linear programming problem having cost minimization as its objective function was developed. The shadow prices from its solution suggested the potential for additional transportation cost savings by increasing the use of rail transportation.

THE FUZE INDUSTRIAL BASE AT NAVAL AIR WARFARE CENTER WEAPONS DIVISION, CHINA LAKE, CALIFORNIA

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The Naval Air Warfare Center Weapons Division (NAWCWPNS), China Lake, California, is responsible for the development and integration of missile fuzes for the Navy. NAWCWPNS is experiencing problems in acquiring fuzes that meet Government specifications. The purpose of this study has been to identify and propose solutions to these problems. A survey was conducted to obtain data from fuzing community experts, and the problems and solutions so obtained are provided. The five principal issues covered in detail are: (1) decreases in the fuze industrial base, (2) ambiguous or faulty specifications, (3) the fuze acquisition award process, (4) contract performance, and (5) the adversarial relationships that exist between contractors and the Government. Conclusions are drawn and recommendations for enhancements to the fuze industrial base are provided.

APPLYING TOTAL QUALITY LEADERSHIP TO AN AVIATION SQUADRON

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The implementation of Total Quality Leadership has been successful in several Department of Defense organizations. However, an aviation squadron provides an unique environment for the application of TQL. This thesis describes an adaptation of the NPRDC TQM process improvement model for a fleet squadron which includes the Shewart Cycle, customer supplier relationships, and mission deployment. Dr. W. Edwards Deming's 14 points are discussed in the context of the squadron environment. Continuous process improvement tools are explained and demonstrated using squadron examples.

THE FEASIBILITY OF RADIO FREQUENCY IDENTIFICATION IN LOGISTICS APPLICATIONS

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The objective of this paper is to examine Radio Frequency Identification (RF/ID) as a possible automatic identification system to assist in managing material assets in the DoD Supply system. The feasibility of implementing RF/ID is the principal question examined. This paper discusses the characteristics, capabilities, and limitations of RF/ID as well as advantages and disadvantages. The paper will analyze the necessary elements to consider in implementing RF/ID. This study will serve as a feasibility and implementation guide in determining requirements for deploying a RF/ID system. A radio frequency identification system can provide many benefits to the military logistics system. Abnormal environments (i.e, harsh, high relative speeds, etc.) offer ideal circumstances for RF/ID. The feasible implementation of a RF/ID system is primarily a question of cost, in which the cost savings contributions to the objectives of the DMR initiative must be appraised.

PREPARING FOR THE UNEXPECTED, CONTRACTING IN CONTINGENCY SITUATIONS

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The purpose of this study was to evaluate the quality of the preparation that contracting professionals receive prior to contingency contracting situations. This was accomplished by exploring the literature on this subject and then comparing the findings and recommendations found with recent experience of contracting professionals returning from Desert Shield and Desert Storm. Contingency contracting issues analyzed include the identification of critical demands, effectiveness of current preparation, effects of laws and regulations, and contingency contracting tools. As a result of this analysis, it can be concluded that current instruction and on-the-job training is sufficient to provide contracting professionals with the requisite competence for contingency contracting situations. There is a need to involve contracting professionals early in the contingency planning process. Current laws and regulations did not constrain procurement of supplies and services during Desert Shield/Storm. The use of contingency contracting tools are paramount to the success of the contracting function in a contingency contracting situation and need to be assembled well in advance. This study recommends the continued education and training of contracting professionals in its present form, raising the thresholds for SF 44's and small purchase procedures for contingency situations, and improvement of contingency contracting kits.

ANALYSIS OF CONSOLIDATING NAVAL AVIATION DEPOTS

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Master of Science in Management-December 1991
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This thesis is a study of the Naval Aviation Depot streamlining and consolidation as a result of Defense Management Review Decision (DMRD) 908. The Navy has conducted extensive economical analysis of DMRD 908 but no study of the production operations has been accomplished. This thesis examines the consolidation of the F/A-18 aircraft F404 engine and module repair at Naval Aviation Depot Jacksonville (NADEP JAX), Florida. The major thrust of the thesis is the application of queueing theory and simulation techniques to investigate the effect of production consolidation on the engine and module repair operation at NADEP JAX. The study examines how engine and module turn-around-time (TAT) and work-in-process (WIP) would change when production resources remain constant and the number of engines repaired at the facility increases. The thesis concludes that if all F404 engine and module depot level repair is consolidated at NADEP JAX without an increase in production resources, TAT and WIP will increase and available capacity for surge requirements will be limited.

DEFENSE INDUSTRY AND ITS IMPACTS ON ECONOMIC GROWTH IN KOREA

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Master of Science in Management-June 1992
Advisor: William Gates-Department of Administrative Sciences

This thesis reviews the connection between the Korean defense industry and Korean economic progress. The defense industry has both costs and benefits. Some argue that the benefits outweigh the costs; others argue the reverse. Because of the apparent diffusion of tension between South and North Korea, the domestic pressures to reduce the national defense budget are growing stronger. Consequently, some have questioned whether the Korean defense industry should be maintained. In fact, the Korean defense industry has had both negative and positive effects on economic growth since the early 1970s. It is time to analyze the Korean defense industry and enter a new phase which considers both security and economic implications. The Korean defense industry is still necessary for national security. It can be more helpful for economic growth. In order to improve the Korean defense industry's structure and organization, this thesis suggests desirable future directions for the Korean defense industry based on economic analysis.

TOTAL QUALITY MANAGEMENT IN LOGISTICS: A CASE STUDY FROM THE TRUCKING INDUSTRY

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This thesis investigates the impact of the Total Quality Management (TQM) movement on the logistics industry as a whole, and, more specifically, within the trucking industry. Its focus then narrows to study the practical aspects of implementing a W. Edwards Deming-based quality program within a particular trucking company, Mason Transporters, Inc. The effectiveness of the company's implementation effort is assessed using data collected from a survey questionnaire, formal interviews, and personal observations during an on-site visit by the researcher. Successes and shortcomings of the implementation process are highlighted and discussed.

AN EVALUATION OF THE APPLICATION OF THE COST ACCOUNTING STANDARDS: A CASE STUDY

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The purpose of this research project was to examine one company's disagreements with Government contract reviewers over the application of Cost Accounting Standards (CAS). Three specific cases of non-compliance, involving CAS 401, 402, 405 and 418, were examined in detail. These cases were selected because of the relative significance of the dollar amounts involved, the extreme variances in interpreting the standards and methods of implementing the standards, and the inordinate length of time it took to resolve the issues. After careful analysis of the three cases, specific conclusions and recommendations are presented. Areas covered include: the Administrative Contracting Officer's (ACO) knowledge of CAS, the ability of smaller companies to adhere to CAS requirements, the Government's policy on cost impact and recovery, the rules regarding the implementation of a new standard, the difficulty in determining the exact cost impact of non-compliance, and problems inherent in the process of resolving non-compliance cases.

AVIATION CONSOLIDATED ALLOWANCE LIST (AVCAL) REDUCTION ANALYSIS

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This thesis provides decision makers with a model to analyze the impact of an Aviation Consolidated Allowance List (AVCAL) reduction onboard aircraft carriers (CVs). The Department of Defense (DoD) is currently down-sizing its forces by 25 percent from FY 1991 to FY 1995 due to the reduction in funding caused by the significant change in the threat assessment. The implications of the current down-sizing of forces are wide-ranging throughout DoD, including the possibility of reducing a CV's AVCAL from 90 to 60 days. Both analytical and simulation models (RP-FOR and RP-SIM, respectively) have been developed. The models measure the impact of reducing an AVCAL from 90 to 60 days by comparing the benefits of savings gained from a reduction of AVCAL, versus the penalties of reduced operational availability of the aircraft.

SPECIAL OPERATIONS AND THE SOLDIER SYSTEM: CRITICAL ACQUISITION ISSUES

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This thesis provides the U.S. Special Operations Command (USSOCOM) technology base manager with an unclassified reference document on the Army's "Soldier System," the collective term for the Army's emerging approach to the research, development and acquisition of items used by the individual soldier on the battlefield. Chapters II - IV outline the emerging approach, discussing the Soldier Modernization Plan, the current Army acquisition structure and process, and the Army Science Board "Soldier as a System" study. Chapter V discusses the acquisition responsibilities of USSOCOM, detailing the evolving relationship with the Army requirement development process for individual soldier items. Chapter VI summarizes the thesis findings assesses the next steps, and makes specific recommendations to USSOCOM. The principal conclusion is that maintaining concurrent and reinforcing combat development, technology base, and top-level program management interface channels with the Soldier System is the most effective way for USSOCOM to influence the Army's process to meet the needs of special operations.

THE ROLE OF THE NAVY COMPTROLLER IN MANAGING THE OMB CIRCULAR A-76 PROCESS

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This thesis examines the role of the Navy field activity comptroller in the acquisition and contracting process under OMB Circular A-76. It contains practical ideas, concepts and comments regarding acquisition and contracting under OMB Circular A-76 by experienced field comptrollers. The thesis is structured toward the newly reported comptroller who has had little, if any, experience in Navy financial management arena. This thesis will provide that comptroller with a basic understanding of the problems and processes involved with acquisition and contracting. It attempts to promote an understanding of contracting under OMB Circular A-76 so that the new comptroller can apply the principles discussed for better decision making in the acquisition process.

DEPARTMENT OF THE NAVY FIELD CONTRACTING ACTIVITIES' CONTRACTING EFFORTS WITH THE FEDERAL PRISON INDUSTRIES, INC.

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One of the mandatory sources of supply for U.S. Government purchase requirements is the Federal Prison Industries, Inc. (FPI). Established by the U.S. Congress in 1934 under authority of the Prison Made Supplies Act, Title 18, USC, 4121-4129, the Federal Prison Industries, Inc., has become a supplier of a wide range of goods and services for Federal Government agencies. Initial research into the attitudes and opinions of Department of the Navy (DoN) field contracting activities toward FPI revealed that many misunderstandings exist and that relations between DoN and FPI could be improved. This study presented some of the problems that exist between DoN and FPI, why they exist, and some recommendations for improvement of those relations.

AN EXAMINATION OF THE SKILLS, EXPERIENCE, TRAINING AND EDUCATION REQUIREMENTS NEEDED AS A FUNCTIONAL AREA 97 OFFICER IN THE ARMY ACQUISITION CORPS

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The passage of the Defense Acquisition Workforce Improvement Act (DAWIA) and the creation of the Army Acquisition Corps have both necessitated a shift in the way the Army acquires and trains its Contracting and Industrial Management (FA 97) officers. This thesis examines the environment of the process of defense acquisition beginning in the early 1980s and traces the history of the legislative procurement reform that lead to the passage of DAWIA and the creation of a separate corps of acquisition professionals in the United States Army. The characterization of the present atmosphere of defense acquisition is an austere one and because of this, FA 97 officers must be trained and educated in the most cost effective and productive manner available. Most importantly, the skills they learn must be those that are the most critical to their future performance in the FA 97 arena. Therefore, interviews were conducted with FA 97 officers in the field to determine which skills, classified into technical and management categories, were the most critical to FA 97 job performance.

THE V-22 TILT ROTOR, A COMPARISON WITH EXISTING COAST GUARD AIRCRAFT

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The Coast Guard Office of Aviation Plans and Programs continues to receive inquiries from several sources about the service's intentions concerning the V-22 tilt rotor aircraft. Officially, decision makers acknowledge that tilt rotor capabilities could be readily adaptable to the service's missions, but acquisition of the V-22 is not contemplated unless the aircraft is first fielded by a Department of Defense component. This thesis serves as a preliminary inquiry into tilt rotor applications for the Coast Guard. The purpose of the study is to determine the implications of a favorable V-22 production decision on the Coast Guard's current mix of aircraft. As background material, the thesis reviews the history of tilt rotor development and outlines the key economic issues at the center of the public policy debate likely to decide the V-22's future. Then, the V-22 Osprey is compared with each aircraft already in Coast Guard service. Both performance characteristics and costs are examined. Lastly, potential Coast Guard V-22 assimilation strategies are discussed.

PARAMETRIC COST ESTIMATION UTILIZING DEVELOPMENT-TO-PRODUCTION RELATIONSHIP APPLIED TO THE ADVANCED AMPHIBIOUS ASSAULT VEHICLE

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This thesis examines the relationship between development unit cost and production unit cost. Historical data from seven armored tracked vehicle programs is used to test the relationship. A study of this relationship is useful when production has not begun and the estimator wants a means to estimate production costs. Using data from the seven programs, parametric estimating techniques are used to examine the relationship between production cost and selected independent variables to determine which provide the best estimators of cost. The data is examined for both disjoint and sequential learning curve theories. The resulting cost estimating relationships (CERs) for each model are explained in terms of how the respective models measure development unit cost and production unit cost. The final CERs provide insight into Advanced Amphibious Assault Vehicle (AAAV) production cost and possible acquisition strategies.

POTENTIAL IMPACT OF THE ELIMINATION OF THE M ACCOUNT ON THE DEPARTMENT OF THE NAVY

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This thesis addresses the impact of Public law 101-510, which eliminated the M Account, on financial management within the Department of the Navy. The M Account was established for the payment of prior year obligations from appropriations which had lapsed. The M Account process provides the necessary flexibility to Navy contract administrators and financial managers to manage resources related to the closure of prior year contracts. Public Law 101-510 was enacted in 1990 based on Congressional concern over Department of Defense management of the M Account. This study examines this law and the impact this legislation will have on future financial decision-making in the Department of the Navy. The assessment focuses specifically on the Procurement and Operations and Maintenance appropriations for the Navy.

NEW DEVELOPMENTS IN FINANCIAL MANAGEMENT IN THE ARMED FORCES

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Recent efforts to reform and consolidate many Department of Defense financial management functions have resulted in numerous initiatives designed to provide cost savings as well as to determine the true cost of the Defense Department. The focus of this thesis is to identify and define these changes as they pertain to the field activity comptroller departments. The results of this thesis will be incorporated into the management guide included in the Practical Comptrollership Course (PCC) offered by the Naval Postgraduate School in Monterey, California, and is primarily intended for use by PCC students as a routine management tool.

NAVAL RESERVE: AN ORGANIZATION IN TRANSITION

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The purpose of this thesis is to examine the issues facing the Naval Reserve as it transitions from its cold war mission to new and, possibly, expanded roles under the New National Military Strategy. The thesis further provides an overview of the changed strategic environment and budgetary concerns that serve as drivers for change within the Naval Reserve. The evolution of the present Naval Reserve organization, manpower and mobilization issues, and the opportunity for organizational reform are also addressed. Additionally, an overview is provided of proposals and directives for expanded reserve participation under the Innovative Naval Reserve Concept. Lastly, conclusions and recommendations are made for facilitation of the ongoing transition.

BASE CLOSURE AND HEALTH COVERAGE: THE CASE OF SILAS B. HAYS ARMY COMMUNITY HOSPITAL AND FORT ORD

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This research focuses on the 1989, 1990 and 1991 utilization statistics of Silas B. Hays Army Community Hospital. These statistics are evaluated including and excluding Active Duty Army and their dependents. These personnel are the principal users of the facility and are expected to be transferred/relocated to Fort Lewis when Fort Ord closes. This thesis forecasts utilization for 1992 and growth rate statistics for the remaining personnel at Fort Ord and the Monterey Peninsula area. This analysis determines whether local area hospitals can support the expected medical requirements of the remaining personnel. A regular trend forecasting analysis was used to predict upcoming year statistics. The data are broken down by armed forces to determine primary usage by individual service (Army, Navy, Air Force, Marine Corps and Coast Guard). Conclusions on adequacy of hospital coverage for users are based on Silas B. Hays Army Community Hospital historical inpatient/outpatient clinical patronage. No financial data were considered in this research. Based on the data and analysis, the research supports closing Silas B. Hays Army Community Hospital as other area hospitals have sufficient capacity to accommodate residual Fort Ord and Monterey Peninsula patients. It was noted in the research that several other areas should be considered before a final decision is made.

A COMPARATIVE STUDY OF GOVERNMENT AND NON-GOVERNMENT ETHICS PROGRAMS, PRACTICES AND POLICIES

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Advisor: Rodney Matsushima-Department of Administrative Sciences

This thesis studied the ethics programs, practices, and policies of both Government and non-Government contractors. The environment in which these programs, practices, and policies have been developed is presented. Academic attitudes are provided regarding the necessity for and effectiveness of ethics legislation directed toward Government contractors. The objective of this study was to identify both similarities and differences between Government and non-Government contractor ethics programs, practices, and policies, and to determine whether or not unique legislation directed toward Government contractors makes a difference in the content of ethics policy documents. A survey was developed and used for ranking and analysis of primary areas of ethical interest to contractors. The thesis concludes that the ethics policies of Government and non-Government contractors are almost identical. While rankings of the relative importance of individual ethical concerns varies, the overall content of all programs is the same. Further, academicians are in disagreement as to the need for unique ethics standards and legislation for Government contractors as opposed to non-Government contractors. The thesis provides alternatives to efforts to legislate the content of contractors' ethics programs.

AN ANALYSIS OF THE NAVY'S PERMANENT CHANGE OF STATION PLANNING PROCESS AND MOVE FORECASTING MODELS

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Advisors: Stephen L. Mehay & Thomas P. Moore-Department of Administrative Sciences

This thesis provides a general overview and appraisal of the Navy's Permanent Change of Station (PCS) planning process, with an emphasis on PCS Move Forecasting Models. A study was conducted of all organizations with a role in the management and budgeting of PCS funds. Interviews were conducted with representatives from each organization in order to determine the flow of information between these organizations, and to identify the processes involved in PCS management. This thesis further evaluated the PCS move models currently used to forecast PCS move requirements. Finally, this thesis evaluated a prototype model developed by the Navy Personnel Research and Development Center which attempts to quantify the impact of a PCS account reduction on personnel unit readiness.

APPLYING TOTAL QUALITY LEADERSHIP TO AN AVIATION SQUADRON

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and
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The implementation of Total Quality Leadership has been successful in several Department of Defense organizations. However, an aviation squadron provides an unique environment for the application of TQL. This thesis describes an adaptation of the NPRDC TQM process improvement model for a fleet squadron which includes the Shewart Cycle, customer supplier relationships, and mission deployment. Dr. W. Edwards Deming's 14 points are discussed in the context of the squadron environment. Continuous process improvement tools are explained and demonstrated using squadron examples.

THE MOST EFFICIENT ORGANIZATION: A STRATEGIC ISSUE MANAGEMENT CASE STUDY

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Master of Science in Management-December 1991
Advisor: Nancy C. Roberts-Department of Administrative Sciences

This thesis is a series of case studies that chronicle the reorganization (decentralization, product/market restructuring) of a Public Works Department on board a Naval Air Station. The organization, environment, events, and personnel involved in the development, implementation, and management of a major departmental *RIF and reorganization are documented.*

BUDGET REFORM AND THE BUDGET ENFORCEMENT ACT OF 1990

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In theory, the budget process provides multiple opportunities to articulate claims and ration resources in a methodical and rational manner. However, the American Federal budget process of the 1980s was, in reality, far different from the procedural tranquility theory might suggest. This thesis studies the perceived need for reform of the Federal budget process. It examines the proposals of the Executive Branch, of the Legislative Branch, and of selected experts on budget theory. The process, as enacted in the Budget Enforcement Act of 1990, is examined. The enactments are compared with the proposals for procedural reform and an assessment of which faction was in closest agreement is provided.

FORECASTING HIGH-TECH ASVAB SCORES

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The development of a model for estimation of a high-tech market population will help determine an efficient allocation of recruiting resources. Using data from the National Longitudinal Survey of youth (NLSY), regression equations were developed to estimate the probability that a 17 to 21 year old high school graduate will score high enough on the Armed Services Vocational Aptitude Battery (ASVAB) to be classified into a high-tech rating. This probability is modeled as a function of sociodemographic variables including gender, race/ethnicity, parents' education, poverty status, income, residence in an urban area, and receipt of welfare payments. The results should facilitate calculations of nationwide, country-level, high-tech market distributions.

COLLATERAL DUTY JOB SATISFACTION AMONG COAST GUARD AVIATORS

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This research sought to determine if collateral duty job satisfaction is related to a Coast Guard aviator's career satisfaction and retention plans, which are the most and least satisfying collateral duties, and if various job, management, and individual characteristics are related to collateral duty satisfaction. Data were obtained from a questionnaire which was sent to all duty-standing aviators at Coast Guard air stations. Using statistical analysis techniques and reviews of qualitative comments, the data were analyzed and results obtained. Collateral duty satisfaction is fairly strongly related to career satisfaction, and to a lesser degree, retention plans. Aviators tend to be positively satisfied with their collateral duty, with the Engineering department offering the most satisfying collateral duties while the Administration department tends to offer the least, but still positively satisfying, collateral duties. Job and management characteristics are very influential on collateral duty satisfaction, and while the influence of various characteristics vary among officer rank, the five most influential characteristics for Coast Guard aviators overall are autonomy, task significance, being able to influence which collateral duty is assigned, leadership opportunities, and satisfaction with the supervisor. While collateral duty satisfaction tends to be positive, aviators are dissatisfied by the conflict resulting from not having enough time to maintain proficiency in both aviation (primary) and collateral duties.

RESISTANCE TO TOTAL QUALITY LEADERSHIP CHANGE: AN EVALUATION OF INDIVIDUAL MARINE RESPONSES TO TQL PRINCIPLES AND CHANGE

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This thesis is an attempt to make available to Marine Corps planners data gathered about predispositions of Marines of different ranks to changes prompted by the implementation of Total Quality Leadership (TQL). A survey was conducted to examine the attitudes of 331 Marine Corps staff noncommissioned officers (SNCOs) and commissioned officers concerning different examples of TQL changes. Criteria were developed for identifying the incidence of resistance by rank to these changes and for identifying characteristics that may influence group response. The results serve to identify that while the principles of TQL do not meet identifiable resistance among Marines surveyed, certain TQL changes seem threatening to specific groups. Change, resistance to change, and resistance to Total Quality Management/Leadership are explored. Ways to overcome the resistance identified are discussed.

FACTORS AFFECTING POST-SERVICE WAGE GROWTH FOR VETERANS

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This thesis analyzes factors affecting the post-service earnings and wage growth of veterans. The 1979-1987 National Longitudinal Survey of Youth was the source for the data. Log-earnings regression models were estimated for the 1982 and 1985 surveys. Veteran status was found to have a negative effect on earning in 1982, but had no effect on earnings in 1985. The most important single factor affecting earnings in these two years was the local unemployment rate. It was also discovered that the determinants of earnings in 1982 differed significantly between civilians and veterans. Earnings growth equations were estimated for the period 1982 until 1985. Veteran status was found to have a large positive effect on wage growth. This effect disappears after approximately five years.

THE V-22 OSPREY: A CASE ANALYSIS

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Master of Science in Management-June 1992
Advisor: Alan W. McMasters-Department of Administrative Sciences

This thesis is a case analysis of the V-22 Osprey program. It examines the history of tilt-rotor technology, as well as the history of the program management. Congressional, OSD and USMC/USN interplay is detailed chronologically from 1980 through to 1991 with particular reference to Congressional action during this period. Various studies and simulations are analyzed with the objective of establishing the V-22 as an aircraft which is capable of fulfilling wide-ranging mission criteria established by the Services much more effectively and efficiently than current or planned aircraft. The commercial and foreign military sales markets for the V-22 are also examined. This thesis concludes that the tilt-rotor concept has considerable worldwide potential for both military and civil applications.

AN ANALYSIS OF NAVY, MARINE CORPS, AND ARMY FOOD SERVICE CONTRACTING

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The purpose of this thesis was to examine the major difficulties associated with administration of food service contracts in the Army, Navy, and U.S. Marine Corps. Specifically, pre-award causes of these difficulties, actions taken by Government contract administration officials, and reactions of contractors to these difficulties have been identified. Actions both Government and industry can take during pre-award and post-award to improve the performance of food service contracts are recommended. An informational background for food service contracting has been developed. Armed Services Board of Contract Appeals and protests to the Comptroller General were examined in detail; General Accounting Office (GAO), Army Audit Agency, and Navy Audit Service reports relative to food service contracting were reviewed; and mail survey results of Government officials and contractors were presented to determine the major difficulties associated with administration and performance of food service contracts. The thesis describes how administration and performance difficulties are caused by pre-award actions by the Government, and how corrective actions can significantly reduce the incidence of difficulties, and failure, of food service contracts.

NAVY AND MARINE CORPS INDUSTRIAL ACTIVITIES; A GUIDE FOR THE COMPTROLLER

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The focus of this thesis is to identify the prerequisite knowledge required by the Navy and Marine Corps financial manager in the area of industrial fund activities. Research at the headquarters and field activity levels has provided practical policies and procedures that have been combined with existing financial management directives, manuals and instructions to produce a management guide for incorporation in the Practical Comptrollership Course (PCC) and Financial Management in the Armed Forces Course offered by the Naval Postgraduate School in Montery, California. It is primarily intended for use by these students as a management tool for job turnover, reference, and training.

THE DESIGN OF A PROTOTYPE PERSONAL COMPUTER DATABASE FOR THE EXPERT SYSTEM ADVISOR FOR AIRCRAFT MAINTENANCE SCHEDULING (ESAAMS)

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Master of Science in Information Systems-March 1992
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The Expert System Advisor for Aircraft Maintenance Scheduling (ESAAMS) was originally proposed in 1985 to assist in the scheduling of maintenance discrepancy repair in the organizational squadron environment. This dynamic environment produces a continuous flow of maintenance documentation from each maintenance action. Presently there exists no single system for the maintenance expert to retrieve this information to assist him, or her, in the critical maintenance decision making process. This thesis addresses the design of the ESAAMS database which is of paramount importance to the expert system. Research on the use of the Naval Aviation Logistics Data Analysis (NALDA) database for a personal computer-based database, is documented. Review of other existing naval aviation database systems are included in this research. Based on interviews with experienced fleet aviation maintenance managers, a prototype database design is produced. This thesis concludes with recommendations for further study based upon the findings of this research.

MANAGING THE CONTRACT CLOSEOUT PROCESS

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The primary objective of this thesis was to review the closeout process within DoD activities and determine how the process might be made more efficient. Secondary objectives include identifying the problems in the current process and determining the impact of failure to close out contracts in the time frame stated in the Federal Acquisition Regulation (FAR). Finally, a Contract Closeout Process Summary has been developed as a by-product of this thesis. This guide can be utilized as a training aid or procedures manual.

PARAMETRIC COST ESTIMATION FOR AMPHIBIOUS ASSAULT VEHICLE'S LIFE CYCLE COSTS

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This thesis investigates the need to predict life cycle cost in the most effective and efficient manner through the development of cost estimating relationships (CERs) using only performance input parameters. Utilizing statistical software especially developed for program managers, parametric cost estimating relationship module (PACER), CERs were developed and then evaluated for statistical soundness. The object of this study was to develop a means by which the program manager could fairly accurately total life cycle costs. With this information in hand, the program manager could determine if a weapon system is affordable early in the acquisition process. The results of this study was the derivation of three predictive models that relate cost to required performance parameters. Based solely upon performance requirements, a relationship between cost and required performance was established and their impact upon life cycle costs.

A COMPARISON OF ALTERNATIVE METHODS OF OBTAINING DEFENSE LOGISTICS AGENCY (DLA) COGNIZANCE SPARE PARTS FOR CONTRACTOR FURNISHED EQUIPMENT (CFE) DURING INITIAL OUTFITTING OF NEW CONSTRUCTION U.S. NAVY SHIPS

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M.A., Colorado State University, 1978
Master of Science in Management-December 1991
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This thesis is a limited determination of the most cost effective method of acquiring Defense Logistics Agency (DLA) cognizance initial outfitting material for new construction ships. The study is restricted to Contractor Furnished Material (CFM) required to support Contractor Furnished Equipment (CFE) contained in the Hull, Mechanical, Electrical, Ordnance and Electronics (HMEO&E) Coordinated Shipboard Allowance List (COSAL). Three alternative methods of procuring the material are analyzed for cost effectiveness: (1) the shipbuilder procures the material commercially, (2) the shipbuilder is allowed access to the Federal Supply System (FSS) and requisitions the material, (3) the Naval Supervising Activity (NSA) requisitions the material from the FSS in which case it becomes Government Furnished Material (GFM). Material availability using each of the alternatives is also examined.

PLANNING, PROGRAMMING AND BUDGETING FOR TRAINING CONDUCTED EN ROUTE BETWEEN PERMANENT DUTY STATIONS: A COMPARISON OF THE MILITARY SERVICES

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The requirement to provide en route temporary duty training is not unique to the Navy, but is a requirement common to all four military services. This thesis is a comparative study as to how the Navy and its sister services plan, program and budget for active duty personnel training conducted en route between permanent duty stations. Specific attention will be given to the Navy's Temporary Duty Under Instruction (TEMDUINS). This thesis will also examine related programs used by the United States Army, Air Force and Marine Corps to determine how they manage their en route training activities. The focus will be on both the mechanics of their respective planning, programming, and budgeting processes, and managerial interactions and management control procedures used.

IDENTIFICATION OF BARRIERS TO MORE EFFECTIVE AGRICULTURAL WATER MANAGEMENT IN THE SALINAS RIVER VALLEY

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The Salinas River Valley is currently in its fifth straight year of drought. Groundwater is becoming increasingly more important to the economic future of this agriculturally dominated valley. Continued consumption of groundwater at the current rate threatens the economic and environmental future of the Valley through excessive overdrafting of the underlying aquifer and through the phenomenon of "seawater intrusion." This thesis identifies the physical, economic, social and political barriers to more effective agricultural water management from the perspective of the individual grower, through the use of a comprehensive survey. This study will contribute to a better understanding of the major water conservation issues and barriers from the individual grower's perspective. It will provide useful information to decision makers in arriving at water conservation policies that are both equitable and in the best long-term interest of the various water users of the Salinas River Valley. By exploring the multiple dimensions of specific issues, the perceived and real barriers and the perceptions of interested parties, this study will help foster better awareness, cooperation and communications between the county agency responsible for water resources management and the individual agricultural growers.

APPLICATION OF A TAXONOMICAL STRUCTURE FOR CLASSIFYING GOODS PROCURED BY THE FEDERAL GOVERNMENT

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The concept of contracting as a science has been explored in depth in procurement research over the past several years. One of the most intriguing research efforts involved the development of a model for the classification of goods. This thesis describes the application and validation of the previously developed scheme for classifying items procured by the Federal Government. Three distinct homogeneous groups of goods (food service equipment, ship and marine equipment, and items unique to the P-3 ORION aircraft) were identified and classified using data collected from actual buyers of these goods. The primary objective of the research effort was to actually classify goods by using taxonomic methods, and in doing so, to validate the scheme for the classification of Government goods. Secondary objectives were to identify any improvements to be made to the scheme, and to propose potential applications for the model. The researcher was able to successfully apply the model to a diverse set of goods using the taxonomic methods outlined in the scheme, and provided some suggestions for improvement.

THE ADVANCED TRACEABILITY AND CONTROL SYSTEM PERFORMANCE DATA ANALYSIS

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The purpose of this thesis is to determine the actual time measurements associated with the various steps of the Advanced Traceability and Control (ATAC) process to evaluate significant policy decisions such as the Defense Management Review Decision (DMRD) 901's "ship or hold" decision. As the first step, a review of the operation of ATAC is presented. Additionally the ATAC Plus program, which represents the future of Navy carcass management, is described. Next, the data base maintained by Navy Material Transportation Office (NAVMTO) is analyzed and the results are presented. Further research is recommended to develop an elaborate simulation model to allow the development of a comprehensive processing policy for each repairable item.

THE PRINCIPAL PROBLEMS WITH THE ADMINISTRATION OF SERVICE CONTRACTS AT A SHIP REPAIR FACILITY

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The primary objective of this thesis is to identify the principal problems encountered by a Navy ship repair facility during the administration of engineering and technical service contracts. A background discussion of contract types and the applicable regulations is provided. The identification of the principal problems is accomplished through a review of historical audit results. This review focuses on the principal problem areas of: 1) vague Statements of Work, 2) incomplete or biased independent Government cost estimates, 3) failure to properly perform Contracting Officer's Technical Representative (COTR) duties. The study then determines the frequency and severity of these problem areas at the site studied through a series of field interviews. An analysis of the background causes of these problems and their impact upon the ship repair facility is presented. A discussion of recommendations that would reduce or avoid the problem areas is offered.

THE DEFENSE ENTERPRISE PROGRAM: A MANAGERIAL ASSESSMENT

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The DoD acquisition community frequently reports that micromanagement and overregulation reduce acquisition efficiency. The Defense Enterprise Program (DEP) was an initiative approved by Congress in response to Packard Commission recommendations to improve the acquisition process. The DEP initiative allowed DoD to experimentally reduce regulatory requirements, streamline the acquisition management structure and provide fiscal stability to DoD programs in an attempt to reduce micromanagement. However, the initiative failed to provide significant benefits for the designated programs. The causes of the DEP failure fell into these three broad categories; 1) Managerial failures in implementation, 2) Failure to address organizational resistance to reduced oversight, and 3) Political dynamics of DoD acquisition reform. This study analyzes the difference between Congressional intent and DoD execution of the DEP as well as the impediments to effective DEP implementation. It also examines the characteristics of the DoD acquisition organization and the relationships between DoD and Congress while assessing the impact on the ability to reform DoD acquisition. Lessons learned from the DEP failure may provide insight on the political dynamics of organizational change and enhance the opportunity for successful implementation of future Department of Defense reforms.

RETENTION AND PROMOTION RATES OF NAVAL FEMALE OFFICERS

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The question of which factors influence the retention and promotion rates of female officers across communities in the Navy is the focus of this thesis. This thesis statistically examines the impact of a myriad of socioeconomic and personal variables upon female promotion and retention. Multivariate and logit regression techniques are utilized to analyze and identify the factors that are important in the promotion and retention of female Naval officers. Both socioeconomic and personal characteristics are found to be important variables affecting the promotion and retention rates of female officers.

PREDICTING HIGH QUALITY AFQT WITH YOUTH ATTITUDE TRACKING STUDY DATA

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This thesis demonstrates that Youth Attitude Tracking Study (YATS) data can be used to create a synthetic AFQT classification procedure for distinguishing high quality respondents. Unlike previous methods, the procedure does not rely on interest in the military to predict AFQT category. The estimates are based on an analysis of the YATS data matched with the Defense Manpower Data Center cohort data file using a binomial logistic regression model. The market segment analyzed is 17 to 21 year old males who are either high school graduates or prospective high school graduates. The dependent variable is whether or not a respondent would score above the 50th percentile on the Armed Forces Qualification Test. The explanatory variables reflect individual demographic, educational and labor market characteristics at the time of YATS interview. The YATS time frame is restricted to 1983 through 1985 in order to facilitate future bridging of YATS models with models estimated with similar time period data from the National Longitudinal Survey of Youth (NLSY). Additionally, the models may be used to provide estimates of AFQT quality for more recent YATS respondents.

AN EVALUATION OF DOD UNIT COSTING AS A CONTROL SYSTEM

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The Department of Defense (DoD) is in the process of implementing changes to the financial control system in order to reduce costs. Among the changes are the establishment of a Defense Base Operations Fund and the use of unit costing by support activities involved in the Fund. DoD expects unit costing to be a "business-like" tool which will support resourcing, planning, and the measurement of performance. The purpose of this thesis is to evaluate the current financial control system and, by using a control system framework, determine strengths and weaknesses. The findings are used to indicate whether a new system was required due to the ineffectiveness of the old system or due to a changing DoD environment. The same framework used to evaluate the current system to evaluate the new unit costing system. The ability of the system to be a resourcing, planning, and measurement tool is analyzed from the point of view of the control system designer.

A DICTIONARY OF ACQUISITION AND CONTRACTING TERMS

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This thesis is part of a joint research project between students of the Naval Postgraduate School in Monterey, California and the Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. The purpose of the research is to establish working definitions for commonly used contracting and acquisition terms and phrases. Twenty-five terms were selected from a master list compiled by previous researchers. Contracting literature and regulations were researched to identify published definitions. The published definitions were used to develop a systhesized definition for each of the twenty-five terms. The synthesized definitions were submitted to contracting professionals for examination. The acceptability of proposed definitions was based upon consensus and the input from respondents was used to develop a refined definition.

BENEFIT/COST ANALYSIS OF INTERDWELLING NOISE CONTROL IN MULTIFAMILY DWELLINGS

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This thesis was undertaken to perform a benefit/cost analysis of interdwelling noise control in multifamily dwellings. Specifically, the benefit/cost analysis was performed to determine whether multifamily dwelling owners would find it economically beneficial to provide multifamily dwellings that are insulated from interdwelling noise. In other words, does the marginal benefit to the owner (additional monthly rent) exceed the marginal cost of providing the added insulation? A questionnaire was used to survey tenants of one multifamily apartment complex in Monterey, California to show that a market does indeed exist for sound insulated multifamily dwellings (i.e., tenants are willing to pay to attenuate interdwelling noise), and that the amount they are willing to pay is relatively large compared to the marginal cost of providing the added interdwelling sound insulation (i.e., the amount that tenants have to pay for additional sound insulation to make the benefit/cost ratio greater than one is relatively small). The survey also ascertained attitudes toward noise where quiet surroundings are important to tenants in deciding where to rent, where noise is annoying to them to a relatively large degree, and where interdwelling noise is more annoying than outdoor noises.

REDUCING SUPPLIER OVERSIGHT: AN ANALYSIS OF SUPPLIER QUALITY ASSURANCE PRACTICES USED BY DEFENSE CONTRACTORS AND MALCOLM BALDRIGE NATIONAL QUALITY AWARD WINNERS

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This study attempted to identify the practices used by defense contractors and recipients of the Malcolm Baldrige National Quality Award to reduce or eliminate the oversight of suppliers. A comparison of the practices used by the companies who responded to a survey questionnaire inquiring about their specific programs was made. An analysis indicates that common oversight reducing practices used by defense contractors and Baldrige winners include supplier certification programs, involving suppliers early and throughout the supply cycle, and developing and assisting suppliers in improving their performance. The research concluded that defense contractors encounter more difficulties than Baldrige winners in establishing cooperative, long-term relationships with suppliers because of requirements and restrictions imposed by the Federal Government. These include rules, laws and regulations that hinder defense contractors' ability to achieve higher levels of quality.

THE DOD UNIT COST INITIATIVE: A NAVY OVERVIEW, ECONOMIC ANALYSIS, AND REVIEW OF BASE OPERATIONS SUPPORT COST ALLOCATION

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The purpose of this thesis is to provide an overview of the Department of Defense (DoD) initiative entitled unit cost resourcing and to review the Navy progress in implementing the unit cost concept initiative. An analysis of the unit cost concept is performed within the context of a microeconomic framework. Additionally the thesis will review the DoD method for allocating Base Operations Support (BOS) costs which are included as part of the unit cost goals. An example alternative allocation method was designed and used for illustrative and comparative purposes only. The history and background of unit cost are also provided. The research consisted of interviewing senior Navy and DoD officials with regard to implementing the unit cost concept and to ascertain its future within the Department of the Navy. The research focused on collecting data from Navy field commands that represent some of the areas in which unit costing will be or has been implemented. The data from the field commands was analyzed and compared to reports generated by the Defense Manpower Data Center (DMDC) at Monterey, California.

PLANNING FOR A DEPARTMENT OF DEFENSE MAIL SERVICE PHARMACY SYSTEM

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This thesis provides a methodology for use in addressing whether or not the Department of Defense should alter the way in which it distributes medications to eligible beneficiaries. The possibility of providing centralized mail-order services as a means of filling prescriptions for maintenance medications is examined. Two major trade-offs are involved. First, the creation of Mail Service Pharmacies (MSP) will provide better services to eligible beneficiaries, including those previously lacking access to prescription services. This will lead to increased demand and costs. A method is provided for determining demand and the cost of medications required to support this demand. Second, the addition of mail-order services may require large capital expenditures for facilities and equipment. The trade-off is system-wide savings in inventory and related costs resulting from the consolidation of prescription dispensing services. MSP system alternatives are examined using a net present value approach. Examples are hypothetical except where stated otherwise.

DEPARTMENT OF DEFENSE IMPLEMENTATION OF THE CHIEF FINANCIAL OFFICER ACT

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This thesis analyzes the provisions of the Chief Financial Officers (CFO) Act of 1990 as they apply to the Department of Defense (DoD). It identifies the background environment in which the CFO Act was formulated and the steps that DoD is taking to implement the law. Particular attention is given to the development of the Federal financial management improvement process, including Congressional committee hearings and arguments for and against the use of Generally Accepted Accounting Principles in the Federal sector. The DoD implementation plan focuses on three key Defense Management Report initiatives as the means to attain the goals and objectives of the CFO Act. Accordingly, the initiatives of Corporate Information Management, Defense Finance and Accounting Service, and the Defense Business Operations Fund are discussed. In addition, Government-wide and DoD efforts to develop and institute audited financial statements and establish CFO qualification standards are explored. Problems in implementation are presented. Specifically, problems with the integration of budgeting and accounting, valuation of weapon systems, accuracy of tracking and reporting inventories, and the adequacy of internal controls are reviewed. Finally, a comparison is made between DoD's efforts relative to action underway in other Government agencies.

INCENTIVES FOR RECRUITERS

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Advisor: David R. Henderson-Department of Administrative Sciences

The purpose of this thesis is to study the different types of incentives for recruiters that are used in the private sector of the U.S. economy and in the U.S. Navy, and to examine how, if possible, incentives that are used for civilian recruiters can be applied to the Navy.

A DECISION SUPPORT STRATEGY FOR THE ACQUISITION OF CVN Q-COSAL TARGET DATE MATERIAL

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In response to the reduced threat against the United States, Congress has directed the Department of Defense to reduce spending. As funds are reduced, targets of opportunity are shifting from the battlefield to the appropriation field. Dollars invested in inventories are a prime target of cost reduction. This thesis examines existing inventory management policies at the Supervisor of Shipbuilding, Newport News, Virginia (SUPSHIPNN). It provides a decision support system, called the *DSS Strategy* model. The results of simulation indicate inventory managers at SUPSHIPNN can use the DSS Strategy model to make decisions that will reduce inventories and meet production target dates. Successful management of inventories is not a cost saving measure alone. The judicious use of valuable inventory and associated resources will maintain the fleet in the highest possible state of readiness within constricting fiscal resources.

CONTRACTING FOR ENGINEERING AND DESIGN SERVICES IN THE ENVIRONMENTAL RESTORATION FIELD

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This thesis examines and analyzes the nature of work in the environmental restoration field. The analysis was conducted using archival and opinion research to define the unique qualities associated with the engineering and design phases of the environmental restoration process. Based on this analysis, justification for the use of cost-reimbursement contracts for the engineering services used in this field is provided. The moral hazard/incentive issue associated with cost-reimbursement contracts is then analyzed. With the moral hazard issue in mind, Naval Facilities Engineering Command's (NAVFAC) choice of the cost-plus-award-fee contract for the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract is evaluated. This evaluation looks at how the use of a long-term cost-reimbursement contract, such as CLEAN, provides incentives to overcome the moral hazard problem.

AN EXAMINATION OF THE TOTAL QUALITY MANAGEMENT (TQM) CONCEPT GIVEN CURRENT FEDERAL/DOD COMPETITION INITIATIVES

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Master of Science in Management-June 1992
Advisor: Rodney R. Matsushima-Department of Administrative Sciences

Quality is vital to our defense and quality improvement is key to increasing productivity. The Department of Defense (DoD) Total Quality Management (TQM) effort has been given top priority by the Secretary of Defense. Many questions exist concerning the problems encountered when implementing TQM throughout DoD. This thesis looks at the compatibility of the TQM philosophy with current Federal Acquisition Regulation competition requirements. The writer concludes that the TQM philosophy implementation is compatible with existing competition policy.

AVIATION DEPOT LEVEL REPAIRABLE CARCASS TRACKING AND BILLING: THE EFFECT OF THE TWO PRICE SYSTEM ON BUDGETING AND FLYING HOUR COST REPORTING

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The purpose of this thesis is to examine problems with the Navy's two price aviation depot level repairable (AVDLR) billing and tracking system. These problems include fluctuations in post fiscal year obligation levels and the distortion of flying hour cost reporting due to AVDLR carcass charges and credits received during the expenditure availability periods of the Operations and Maintenance, Navy appropriations used to fund AVDLR purchases. Fluctuations in post fiscal year obligation levels can potentially result in the unintentional over obligation of funds. Distortions in flying hour costs result in inaccurate flying hour program budget requests. This thesis also explores the feasibility of a two price/one bill system of charging for AVDLRs which has often been proposed as a solution to the problems mentioned above. The conclusion reached is that the problems with the two price system have diminished significantly over time. The two price billing system remains the best means of maintaining system visibility of AVDLR carcasses and holding down overall AVDLR costs

REFINING THE EVALUATION OF INTERNATIONAL CODEVELOPMENT PROGRAMS

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This research examines the evaluation performed by the Navy International Programs Office on United States Navy programs proposed as candidates for international codevelopment agreements. Primary research consists of a spreadsheet analysis of 22 program evaluations conducted by the Navy International Programs office during 1990-1991. Secondary research recounts the history of the U.S. Government's international armaments cooperative efforts from World War II to the present, explores current issues, and examines Department of Defense and Department of the Navy policy and procedures governing international cooperative programs.

COST BENEFIT ANALYSIS OF GENERAL SERVICES ADMINISTRATION's PROPOSED RELOCATION

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Master of Science In Management-December 1991
and
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B.S., Central Connecticut State College, 1978
Master of Science in Management-December 1991
Advisor: Joseph G. San Miguel-Department of Administrative Sciences

General Services Administration is faced with the responsibility of improving its physical distribution capabilities by either upgrading its current facilities or constructing a new facility. A cost/benefit analysis was conducted of all viable alternatives as to the least future cost to the Government while maintaining General Services Administration's current level of service and effectiveness. Of the alternatives analyzed, it was determined that it would be of the utmost benefit to the Government for General Services Administration's Western Distribution Center to relocate at Sharpe Army Depot, current site of a portion of Defense Logistics Agencies Western Distribution Center. At Sharpe, General Services Administration has the greatest potential for cost savings while improving its warehousing ability into the next century. Additionally, there are many potential benefits not addressed, such as consolidation of distribution functions between General Services Administration and Defense Logistics Agency, in order to take advantage of greater cost benefits.

INFLATION ACCOUNTING METHODS AND THEIR EFFECTIVENESS

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This thesis provides an overview of inflation accounting methods and their applications as accounting standards. Constant purchasing power accounting and current cost accounting are explained as the major inflation accounting methods. Inflation accounting standards announced in the United States, Britain, and Canada are presented in a comparative manner. Several empirical studies which examined the usefulness of the inflation disclosures required by the U.S. Financial Accounting Standards Board Statement No. 33 are reviewed to provide information on the effectiveness of inflation accounting methods. These studies produced mixed results. While some showed enhanced information value in inflation disclosures, others showed none.

SOURCES AND CONSEQUENCES OF INTRINSIC TASK MOTIVATION IN ENGINEERS AT THE NAVAL AVIONICS CENTER

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This thesis examines the sources and consequences of intrinsic task motivation in civilian engineers. Using Thomas/Velthouse's model, intrinsic task motivation is measured in terms of four rewards that workers get directly from their work tasks: 1) Impact or the sense that one is accomplishing task goals, 2) Competence or performing task activities skillfully, 3) Meaningfulness or the value of the task purpose to the individual, and 4) Choice or one's ability to choose how to do the task. The analysis is based on data from 372 engineers at the Naval Avionics Center in Indianapolis. Results of the analysis show that the amount of intrinsic task motivation that an engineer feels is strongly related to variables with significant financial implications for the organization, including professional development, stress symptoms, and intention to leave the job. Further, an engineer's "interpretive styles," his/her manager's behavior, and aspects of work group climate were shown to influence the engineer's intrinsic task motivation. Implications regarding management development programs, performance appraisals, and other activities are discussed.

COST BENEFIT ANALYSIS OF THE CREDIT CARD PROGRAM AT THE NAVAL POSTGRADUATE SCHOOL

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Master of Science in Management-June 1992
Advisor: Jerry McCaffery-Department of Administrative Sciences

The purpose of this thesis is to analyze the cost effectiveness of the Government-wide credit card within the Naval Postgraduate School Procurement Department. The intent of the study is to review current management policies relating to the credit card program, analyze the small procurement process and make recommendations on the usage of credit card at Naval Postgraduate School. A questionnaire and cost benefit analysis was developed to explain the credit card at the NPS and compare the BPA, purchase order and imprest fund with the credit card. Card holders and authorizing officials are the operators in this system and were the respondents in the questionnaire. The thrust of the study is to improve the efficiency and effectiveness of the small procurement division in the area of the credit card use. By identifying the cost and benefits of the credit card and other procurement programs, the NPS small procurement division will have the information necessary to determine which method of procurement is most cost effective for a particular purchase.

JOINT OPERATION PLANNING AND EXECUTION

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M.S.S.W., University of Tennessee, 1978
Master of Science in Management-March 1992
and
Karen J. Vigneron-Lieutenant, United States Navy
B.A., Alma College, 1980
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Master of Science in Management-March 1992
Advisors: Dan C. Boger & David Brown-Department of Administrative Sciences

The intent of this research is to facilitate understanding of the joint planning process. The thesis consolidates a detailed description of the joint operation planning process with an indepth narrative of the Joint Operation Planning and Execution System (JOPES). The most current information available is provided on JOPES which is still under development and continues to evolve. The role of defense transportation in joint operations planning and execution is emphasized. An appendix contains a user's manual for the JOPES Computer-Assisted Instruction simulator which operates on a microcomputer. It is specifically tailored for novices and those desiring to learn more about JOPES.

A REGRESSION ANALYSIS FOR UNIT COSTING AT NAVSUP ACTIVITIES

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Unit costing is one of the important issues being faced by the Department of Defense (DoD). The ability to predict the cost required to generate a productive unit output is necessary because of current guidelines regarding the management of the limited resources available to the DoD. This thesis investigated the feasibility of developing such forecasts for the Naval Supply Systems Command (NAVSUP) using regression analysis. The analysis met with little success, most probably because the limited available data has only been recorded over the last 21 months due to the newness of the requirements of unit costing. The one positive result of the analysis was the discovery that some of the cost centers analyzed are affected by seasonality. In addition, the data for the last nine months appears to be better than the previous 12. This may be due to cost centers becoming accustomed to monitoring costs and outputs more precisely than has ever been done before.

THE NAVAL PLANT REPRESENTATIVE OFFICE ORGANIZATION TRANSITION INTO THE DEFENSE CONTRACT MANAGEMENT COMMAND: IMPACTS ON CUSTOMERS

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Advisor: Rodney F. Matsushima-Department of Administrative Sciences

Defense Management Report Decision 916 resulted in the consolidation of all Service Plant Representative Offices into the newly created Defense Contract Management Command. This study focused on the impacts of this consolidation on Contract Administration support of Naval Air Systems Command customers. The results of surveys with Procuring Contracting Officers and Program Managers of the Naval Air Systems Command, Administrative Contracting Officers from four Defense Plant Representative Offices, and industry personnel from four defense contractor facilities are reported. It was concluded that the new Defense Plant Representative Offices are supporting the basic needs of Navy and industrial customers, but not as well as the previous Naval Plant Representative Offices had. Twelve recommendations are presented to correct the deficiencies identified.

THE USE OF LIFE CYCLE COSTING FOR THE ACQUISITION OF NON-MAJOR SYSTEMS AT THE NAVAL REGIONAL CONTRACTING CENTER, DETACHMENT, LONG BEACH, CA

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The use of Life Cycle Costing (LCC) has many potential benefits for the Government. These benefits range from reduced total ownership costs to increased reliability to improved maintainability. However, prior to applying the LCC technique, an analysis should be conducted to determine its usefulness. Consequently, the purpose of this thesis is to assess the applicability of the LCC concept to the purchase of non-major systems at the Naval Regional Contracting Center (NRCC), Detachment, Long Beach. The primary method of achieving this objective was through modifying the Graham LCC Decision Model for Spare Parts so that the Model could evaluate the usefulness of LCC for the purchase of a particular non-major system. Through the use of the Modified Graham LCC Decision Model, telephone and personal interviews, and a thorough literature review, the researcher found the usefulness of Life Cycle Costing for the acquisition of non-major systems at the NRCC, Detachment to be very limited.

IN-PLANT QUALITY EVALUATION (IQUE) AFTER ONE YEAR: A PROGRAM REVIEW

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In-Plant Quality Evaluation (IQUE) is the method by which Government quality assurance personnel assess contractor control over product quality. This study examines the opinions of field level personnel about the accomplishment of IQUE stated goals. The results of surveying over 300 Government and contractor quality assurance representatives are reported. It was concluded that the stated goals of IQUE have not been attained. The majority of respondents felt a period of two to three years was required before a determination of the program could be made. Improved communications and the focus on teamwork by IQUE were found to be significant contributors to improvements in the adversarial relationships found between many Government contractors and the Government.

A PROTOTYPICAL MODEL FOR ESTIMATING HIGH TECH NAVY RECRUITING MARKETS

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Advisor: George W. Thomas-Department of Administrative Sciences

This thesis presents a method for identifying and analyzing the recruiting market for highly technical Navy ratings. A basic model estimates the eligibility for six market segments for four mental outcomes, (1) High Tech, (2) High Quality and Not High Tech, (3) mental category 3B and (4) not eligible for the military labor market. A second model estimates the interest in military employment for each market segment given their likelihood of being qualified for the highly technical ratings. The third model is based on the results of the first two models and estimates the actual joining behavior of each market segment of the high tech market given their level of interest in the military.

CAREER PATHS FOR UNRESTRICTED LINE OFFICERS WITH THE FINANCIAL MANAGEMENT SUBSPECIALTY

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Master of Science in Management-December 1991
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This thesis provides an analysis of the current Unrestricted Line Officer career structures for the Surface, Subsurface and Aviation Warfare Communities. Specifically, the various community career structures are studied in an attempt to identify where progressive development of the Financial Management subspecialty could be accommodated. This information is used to propose career paths, which are designed to ensure that the officer fulfills all necessary requirements for achieving Command. The objective of the proposed alternative career path process, is to produce officers qualified to assume both Command in their respective community, and qualified to assume the most demanding financial management billets in the Navy. In addition, the impact of having the Financial Management subspecialty on the future promotion potential of the Unrestricted Line Officers is analyzed. This portion of the thesis utilizes regression analysis on ten years of promotion data, for various categories of officers. The results are used to compare the promotion potential between the various categories of officers to determine if the Financial Management subspecialty has an adverse or favorable impact on the officer's future promotions and management jobs in the Navy.

AN EXPERT SYSTEM FOR MANAGING STORAGE SPACE CONSTRAINTS ABOARD UNITED STATES NAVAL VESSELS

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This study was conducted to determine if an expert system could be designed to assist the afloat Supply Officer in considering space constraints when developing a deployment loadplan. Forecasting and Operations Research Models are used in the development of the expert system and adapted, as necessary to accommodate supply management afloat. Procedures for determining net stowage capacity and material configuration were reviewed to provide the user with an understanding of how to effectively utilize the expert system for developing a loadplan. The expert system includes a series of LOTUS 123 spreadsheets to be used in conjunction with the Military Traffic Management Command's Computerized Deployment System (CODES). The study concludes that the use of an expert system would provide valuable assistance to the afloat Supply Officer and recommends further research to establish the CODES interface.

JOINT OPERATION PLANNING AND EXECUTION

Karen J. Vigneron-Lieutenant, United States Navy
B.A., Alma College, 1980
M.B.A., University of Detroit, 1982
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Betty E. Tally-Lieutenant, United States Navy
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The intent of this research is to facilitate understanding of the joint planning process. The thesis consolidates a detailed description of the joint operation planning process with an indepth narrative of the Joint Operation Planning and Execution System (JOPES). The most current information available is provided on JOPES which is still under development and continues to evolve. The role of defense transportation in joint operations planning and execution is emphasized. An appendix contains a user's manual for the JOPES Computer-Assisted Instruction simulator which operates on a microcomputer. It is specifically tailored for novices and those desiring to learn more about JOPES.

COST, SCHEDULE, AND PERFORMANCE TRADEOFFS IN THE ACQUISITION OF MAJOR WEAPON SYSTEMS

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In the current period of fiscal restraint, the acquisition of weapon systems has come under ever increasing scrutiny. Costs of these systems are influenced by performance characteristics of the system and schedule demands placed on the acquisition process. The objective of this thesis is to investigate previous research performed in the area of cost, schedule, and performance tradeoffs in the acquisition of major weapon systems. Results of the literature review indicate that several cost-schedule-performance models have been performed in two area: aircraft airframes and aircraft turbine engines. Those models are compiled and explained. Methodological problems associated with tradeoff studies of this type are discussed. An annotated bibliography of relevant source documents is also provided.

AN ANALYSIS OF THE RELATIONSHIP BETWEEN THE FINANCIAL CONDITION OF MAJOR DEFENSE CONTRACTORS AND DOD SPENDING

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The purpose of this thesis is to examine the relationship between the financial condition of defense contractors and the amount of Department of Defense spending from 1975 to 1990. The sample for this study consists of eighteen major defense contractors. The relationships are examined at two levels. The first level is that of the financial condition of the defense industry in the aggregate. The second level is that of the individual defense contractors. The major findings of this study are that: 1) the aggregate industry of defense contractors has experienced a declining financial condition from 1975 to 1990; 2) a positive relationship seems to exist between the financial condition of the defense industry and the amount of defense spending; 3) no consistent relationship between the financial condition of the individual defense contractors and the amount of defense spending is apparent.

REASONS FOR OMB CIRCULAR A-76 CONTRACT COST INCREASES FOR U.S. COAST GUARD ACTIVITIES AND PERCEPTIONS OF THE USCG A-76 PROGRAM

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OMB Circular A-76 (Contracting out Commercial Activities) is a controversial program which directs the Government to rely on the private sector for commercial services when evaluated cost is lower in the private sector. Many A-76 contracts experience cost increases after contract award. An earlier study of three USCG A-76 contracts showed that Department of Labor (DoL) wage determinations and added work caused cost increases, but the contracts were still cost effective. This thesis updated the earlier study of three activities and analyzed three additional USCG commercial activities to see if DoL wage determinations, added work, or additional factors caused cost increases, and what the Coast Guard contracting officer could do to control them. In addition, contract costs were compared with the Government's Most Efficient Organization (MEO) for each activity to see if Government savings were still being realized. There are problems in the implementation of A-76 that may be associated with the perceptions of its effectiveness. To gauge USCG perceptions of the effectiveness of A-76, interviews were conducted with USCG leaders from units with "contracted-out" commercial activities. These were compared with interviews conducted with leaders from units that had the functions remaining in-house.

MORALE, WELFARE AND RECREATION: A FINANCIAL MANAGEMENT GUIDE FOR THE FIELD ACTIVITY COMPTROLLER

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The focus of the thesis is to identify the functions and responsibilities of the Navy field activity comptroller, and to develop a comprehensive financial management guide of the Morale, Welfare and Recreation program. Specifically, the thesis examines the role of the comptroller in the distribution, management and budgeting of MWR funds, determines MWR comptroller requirements and offers useful and practical recommendations to effectively budget and manage MWR funds. The MWR Financial Management Guide will be incorporated in the Practical Comptrollership Course (PCC) offered by the Naval Postgraduate School in Monterey, California and offered to comptrollers in the field as a management tool.

AN ANALYSIS OF THE ROLE OF THE BUDGET COMMITTEES IN THE CONGRESSIONAL BUDGET PROCESS

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Congress assumed a more active role in the Federal budget process with the Congressional Budget and Impoundment Control Act of 1974 (CBA), legislation which created the House and Senate Budget Committees. During the first years of the CBA, these committees were effective in establishing the budget process. In 1981, they contributed to a dramatic shift in fiscal policy. Consequently, the budget process assumed a magnitude which was beyond the purview of a single set of committees. The remainder of decade was dominated by large coalitions and budget summits, obscuring the role of the Budget Committees. In the mid-1980s, concern over the deficit shifted the focus of the budget process further from the Budget Committees. Gramm-Rudman-Hollings legislated deficit totals and instituted the sequester to cut spending when Congress could not. The most recent revision of the budget process is the Budget Enforcement Act of 1990 (BEA), which further displaces the Budget Committees. Past trends suggest the BEA will be superseded by legislation which may further diminish the role of the Budget Committees.

AN INVESTIGATION INTO IMPROVING NON-NPL CLEANUP PROCESS

Mark Everal Whitson-Lieutenant Commander, United States Navy
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Master of Science in Management-June 1992
Advisor: Richard A. Harshman-Department of Administrative Sciences

This research investigates the process required to remediate (cleanup) non-National Priorities List (non-NPL) hazardous waste sites. The research addresses the many laws and regulations on hazardous waste cleanup and specific Department of Defense and Navy processes to correct and remediate existing sites. The thesis gathered data through survey of the seven Engineering Field Divisions within the Naval Facilities Engineering Command organization. The survey provided opportunity to cover concerns of representatives currently involved in cleanup operations for the Navy. The research concludes that NAVFAC should actively endorse a broader use of partnering and teams to quicken the remediation process.

A GUIDE FOR IMPLEMENTING TOTAL QUALITY MANAGEMENT IN THE U.S. COAST GUARD RESERVE

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Master of Science in Management-December 1991
Advisor: Roger D. Evered-Department of Administrative Sciences

Implementing Total Quality Management (TQM) into the United States Coast Guard Reserve involves a major change in the way work is done. The impact will be enormous and universal. Thorough planning must be done to ensure satisfactory integration of TQM. Interviews with the principal officers involved with the TQM initiative were conducted to examine the current status of the project. This study describes the basics of the Coast Guard's TQM philosophy and tools, identifies criteria of successful change, and delineates general techniques for the implementation effort. Resistance to change and overcoming that resistance are explored. A general guide for implementing change in the Coast Guard Reserve is outlined as a product of this research. The guide can be employed so as to be useful for initiating TQM or any new concept into an organization.

AN ANALYSIS OF SELECTED UNITED STATES MARINE CORPS CONTRACTS INVOLVING MINORITY OWNED SMALL BUSINESSES

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Advisor: Stephen Zirschky-Department of Administrative Sciences

The purpose of this thesis was to examine difficulties associated with United States Marine Corps contracts awarded to minority owned small businesses under the 8(a) program. Specifically, causes of contract default and firm failure were identified; indicators which illustrated difficulties leading to default and firm failure were identified and steps which could have alleviated these difficulties and thereby prevented contract default or firm failure were recommended. A historical and legislative background for the 8(a) program has been developed. Six contract cases were examined in detail, in conjunction with a mail survey of USMC contracting officers and small business advocates, to determine the primary causes of contract default and 8(a) firm failure and their indicators. The thesis describes how observable indicators of contract default and firm failure can be recognized and how corrective action can be undertaken to significantly reduce the incidence of default and firm failure when dealing with companies participating in the 8(a) program.

POSTGRADUATE EDUCATION AND PROFESSIONAL MILITARY DEVELOPMENT: ARE THEY COMPATIBLE?

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Master of Science in Management-December 1991
Advisor: Richard Elster-Department of Administrative Sciences

This thesis examines the utilization of graduate education for graduates of the Naval Postgraduate School, Manpower, Personnel, and Training Analysis (MPTA) curriculum, from December 1986 through June 1991. The study focuses on four areas: 1) developing a list and rank structure of billets requiring the xx33P code granted upon completion of the education, 2) tracking the careers of the officers following their graduation from the curriculum, 3) examining career progression paths to find places where timely utilization could be undertaken, and 4) examining the designator composition of population. The study determined that utilization for the period December 1986 through June 1991 was 22.2%. Assuming that all officers still in the two-tour Department of Defense utilization window were assigned to utilization billets as their next assignment, the utilization rate would rise to 52.%. This was deemed unacceptable, and the recommendation was to require an eighteen-month utilization tour immediately following completion of the curriculum. This would cause the utilization rate for MPTA graduates to rise to 97%.

ANALYSIS OF A PROPOSAL TO CONSOLIDATE AIRCRAFT INTERMEDIATE MAINTENANCE CAPABILITIES

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Master of Science in Management-December 1991
and
William Thomas Ainsworth-Lieutenant, United States Navy
B.S., California State University, Sacramento
Master of Science in Management-December 1991
Advisor: Thomas P. Moore-Department of Administrative Sciences

This thesis analyzes the potential for consolidating duplicate capabilities of Navy Aircraft Intermediate Maintenance Departments (AIMD) located in the same geographical area. The expected benefits and drawbacks of consolidation are examined. Benefits discussed are manpower reduction, support equipment reduction, inventory reduction, and increased productivity. Drawbacks discussed are transportation costs, facilities modification costs, impacts to customer service, additional maintenance management and administrative responsibilities, and reduced military resiliency. The thesis discusses options regarding the organizational and service levels consolidated, candidates for consolidation, siting of consolidated repair capabilities, and management of consolidated items. The thesis also analyzes commonality in manning, automatic test equipment, and specific component repair capabilities of the two AIMDs located in San Diego, California: Naval Air Station North Island AIMD and Naval Air Station Miramar AIMD.

MASTER OF SCIENCE
IN
MECHANICAL ENGINEERING

NUCLEATE BOILING HEAT TRANSFER STUDY OF DIRECT IMMERSION COOLING OF A 3X3 ARRAY OF VERTICALLY ORIENTATED ELECTRONIC COMPONENTS IN A DIELECTRIC LIQUID

Frank A. Arata-Lieutenant, United States Navy
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Advisor: Matthew D. Kelleher-Department of Mechanical Engineering

Direct application of two-phase heat transfer in the liquid cooling of electronic components in fluorinated hydrocarbons (FC-72), is severely inhibited by the excessive amount of superheat required to initiate nucleate boiling. This phenomena is well documented. To experimentally study the effects of nucleate pool boiling, a test chamber was constructed. This chamber utilized a 3x3 array of vertically orientated electronic components and a platinum wire of 0.05 mm diameter. The wire was progressively heated to produce a plume of increasing intensity. A study was made on the effect a boiling wake plume had on the heat transfer from the chips.

A NUMERICAL STUDY OF DYNAMIC CRACK PROPAGATION IN COMPOSITES

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B.S., Turkish Naval Academy, 1985
Master of Science in Mechanical Engineering-September 1992
Advisor: Young W. Kwon-Department of Mechanical Engineering

A numerical study was performed to investigate the dynamic crack propagation in fibrous composite plates utilizing the finite element method. A rectangular plate of uniform thickness, which had a propagating central crack, was used for the study. The plate was a unidirectional composite panel and the load was applied in the longitudinal direction of the composite plate. Fracture energies were calculated for given speeds of cracks. The objective of the study was to examine the effect of different composite material properties, crack speeds, and densities on the fracture energy. The discontinuous node-release technique was used to model the crack propagation. The numerical study showed that the fracture energy was higher for a lower elastic modulus ratio, if all other conditions were held the same. Furthermore, a lower crack propagation velocity of a lower material density resulted in a higher fracture energy, respectively, provided the rest of the parameters held constant.

ON-LINE IDENTIFICATION OF THE SPEED, STEERING AND DIVING RESPONSE PARAMETERS OF AN AUTONOMOUS UNDERWATER VEHICLE FROM EXPERIMENTAL DATA

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Master of Science in Mechanical Engineering-March 1992
Advisor: Anthony J. Healey-Department of Mechanical Engineering

The experimental response data from autonomous maneuvering using the NPS AUV II vehicle has been analyzed with a view to defining Kalman filters to provide on-line estimates of system parameters and their variability. Kalman filters, designed for parameter estimation are expected to be the first step in the development of autonomous fault detection systems for underwater vehicles. Secondly, extraction of vehicle hydrodynamic coefficients from these parameters can help to develop vehicle dynamic simulators. Thirdly, knowledge of these parameters will allow the design of improved autopilot and guidance laws.

FINITE MEMORY MODEL FOR HAPTIC RECOGNITION

Philip G. Beierl-Lieutenant Commander, United States Navy
B.S., Massachusetts Institute of Technology, 1980
Master of Science in Mechanical Engineering-December 1991
Advisor: Morris R. Driels-Department of Mechanical Engineering

This study attempts to model the process by which humans identify remote objects using a force-reflecting telemanipulator in order to apply this understanding to future ROV designs employing the concept of telepresence. A theoretical model is proposed in which object identification is dependent primarily upon feature identification and capacity to remember the sequence of features. A computer simulation of this model is constructed and used to produce theoretical object identification performance which can be compared to actual human performance. The capacity for short-term memory of a sequence of features is also studied in a laboratory using a telemanipulator.

EFFECT OF SURFACE COATING ON CYLINDERS SUBJECTED TO UNDERWATER SHOCK

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Master of Science in Mechanical Engineering-September 1992
Advisor: Young W. Kwon-Department of Mechanical Engineering

The response of a composite cylinder (metallic cylinder coated with a rubber material) subjected to an underwater explosion was analyzed numerically. Qualitative differences between coated and uncoated cylinders were investigated. The dynamic response of the coated cylinder was found to be adversely affected when impacted by an underwater shock wave under certain conditions of geometry and material properties of the coating. When adversely affected, significant deviations in axial and hoop stress and strain values were observed. The coated cylinder exhibited larger effective plastic strain and higher residual internal energy in the metallic material. Rubber coatings appeared to inhibit energy dissipation from the metallic material to the surrounding water medium. A parametric study of various coatings was performed on both aluminum and steel cylinders. The adverse effects of the coating decreased when the shear modulus of the rubber was increased or when the rubber thickness was increased, indicating the existence of threshold values for these parameters. The results of this study indicate that the stiffness of the coating is a critical factor involving these threshold values.

THERMOMECHANICAL PROCESSING OF ALUMINUM ALLOY 2519 FOR GRAIN REFINEMENT AND SUPERPLASTICITY

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Thermomechanical processing (TMP) methods developed for Al-Mg and Al-Mg-Li alloys have been modified and applied to the commercial 2519 Al-Cu alloy. The TMP included initial overaging and was designed to facilitate particle-stimulated nucleation (PSN) of recrystallization during controlled reheating intervals between successive rolling passes of the process. Effects of TMP variables were evaluated by tensile testing at temperatures ranging from 300-450°C. Strain rates varied from 6.7×10^{-5} s^{-1} to 6.7×10^{-3} s^{-1}. Also, microstructural analysis was conducted to determine the effect of the processing on the microstructure. The further evolution of microstructure during superplastic testing of the material was also assessed. Refinement to grain sizes below 10 μm by PSN was achieved. Superplastic ductility of 260 pct. was limited by grain growth.

DYNAMIC RESPONSE OF CYLINDRICAL SHELLS TO UNDERWATER END-ON EXPLOSION

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Both numerical and experimental analyses were performed to investigate underwater shock propagation and the induced nonlinear response of cylindrical shells with end caps. The cylinders were subjected to shocks from explosive charges at 12 inches (near-field) and 28 feet (far-field) from the cylinder. An underwater shock test was also performed with the far-field explosion. The numerical results were compared with the experimental data. Stresses and strains occurring in the structure as well as the pressure in the water were studied. The far-field explosion caused the largest circumferential deformations close to both end plates and an accordion oscillatory motion of the cylindrical shell. The near-field explosion caused severe plastic deformation in the neighborhood of the closest end plate to the charge. The stiffeners had, as expected, a larger effect on the circumferential stresses than on the longitudinal stresses. The measured and calculated strains agreed well qualitatively near the remote end plate from the charge.

THE DEFORMATION CHARACTERISTICS AND MICROSTRUCTURAL DYNAMICS OF AN AL-10MG-0.1ZR ALLOY

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An investigation into microstructural evolution during processing and superplastic deformation of an Al-10Mg-0.1Zr alloy was conducted. Processing schedules were modified to enhance particle-stimulated nucleation of recrystallization and refine subsequent grain size. Strain rates varying over three orders of magnitude were utilized in subsequent testing of processed material. At lower strain rates of about $10^{-4}sec^{-1}$ coarsening of the microstructure was apparent and elongations of 277% were obtained. A strain rate of $10^{-3}sec^{-1}$ resulted in lesser coarsening and elongations of 650%. A model of deformation by grain boundary sliding in association with microstructural coarsening is presented.

OPTIMUM DESIGN OF ISOTROPIC MONOCOQUE AND RING-STIFFENED CIRCULAR CYLINDRICAL SHELLS SUBJECT TO EXTERNAL HYDROSTATIC PRESSURE

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The objective of this research is to create a flexible code which is to be used in the investigation of optimum (minimum weight) shell designs. A shell analysis/design program (DAPS3) and a general purpose numerical optimization program (ADS) are incorporated into a single code (THESIS). This code provides the user great flexibility in changing the design variables and constraints which model the optimization problem. The optimum designs produced by this code are compared to DAPS3 optimum designs in order to identify any improvements made by the numerical optimization technique.

OPTIMUM DESIGN OF EXPERIMENTS IN COMPOSITE RELIABILITY

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Many composite material applications require a high degree of safety and functionality. This demands that reliability be incorporated in composite design. The design prediction of reliability requires a parametric model based on the failure processes in strength and life. The estimation of the model parameters requires large data set usually limited by time and equipment. The objective of this investigation is to provide, via simulation, a statistics based rationale of experiment design. The result enables multiple use of limited equipment through scheduled censoring to optimize information.

PROCESS-DEPENDENCE OF PROPERTIES IN HIGH THERMAL CONDUCTIVITY ALUMINUM NITRIDE SUBSTRATES FOR ELECTRONIC PACKAGING

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The development of secondary phases due to the presence of Y_2O_3 additions during sintering of Aluminum Nitride was studied. Depending on the amount of Y_2O_3 added, two non-equilibrium phases (cubic $YA1O_3$ and orthorhombic $A1YO_3$) were found to be present at room temperature, in addition to equilibrium $A1_5Y_3O_{12}$ and $A1_2Y_4O_9$. Sintering at increasing temperatures was found to alter the proportions of the above phases. This appreciably affected physical properties and mechanical properties like density, stiffness, strain to fracture, and failure morphology. These changes were rationalized on the basis of the microstructural effects of sintering. TEM studies were also conducted to investigate the evolution of bulk and surface defects in sintered A1N during processing. In the low Y_2O_3 containing samples, heat treatment at 1850°C resulted in a 2 phase mixture of Y-aluminate and γ -$A1_2O_3$ at the triple grain boundaries in A1N. Based on these results, a mechanism for the sintering process is proposed.

SHOCK QUALIFICATION OF COMBAT SYSTEMS EQUIPMENT USING TUNED MOUNTING FIXTURES ON THE U.S. NAVY MEDIUMWEIGHT SHOCK MACHINE

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Shipboard combat systems must be designed to withstand moderate to severe excitation induced by underwater explosion. Current specifications for combat systems shock qualifications are mandated in MIL-S-901D. Analyzing the differences and relationships between the predicted shock excitation, as derived from previous ship shock trials, and that shock excitation which is produced by the U.S. Navy Mediumweight Shock Machine required by MIL-S-901D, a proposed modification to the existing shock test procedure is presented which will better represent the shock phenomena experienced by combat systems exposed to underwater explosion.

THE EFFECT OF SECONDARY THERMOMECHANICAL PROCESSING PARAMETERS ON THE AMBIENT TEMPERATURE BEHAVIOR OF 10% VOLUME 6061 AL-ALUMINA METAL MATRIX COMPOSITE

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Thermomechanical processing (TMP) was conducted on a 10 volume percent, 6061 Al-Al_2O_3 particle reinforced 'metal-matrix composite' (MMC). The TMP employed consisted of isothermal rolling with intermediate annealing using a schedule of reduction with constant strain per pass for most of the schedule. The as-processed material exhibited high strength while simultaneously achieving ductility comparable to that of the unreinforced 6061 matrix alloy. In the fully annealed condition, the composite's strength and ductility were essentially equal to those of the unreinforced aluminum. An aging study showed accelerated aging and greater peak strength for the composite. Finally, a process and heat treatment combination was established in an attempt to optimize simultaneously the strength and ductility of the composite. It was found that the composite could be aged to a peak strength of 340 MPA while retaining a ductility of 14 percent elongation to failure.

OPTIMUM POSE MEASUREMENTS FOR KINEMATIC PARAMETERS IDENTIFICATION

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A six degree of freedom robot manipulator arm, a PUMA 560, is calibrated using random subsets of available experimental calibration data. Some of these subsets produce good calibration results motivating the search for an optimum calibration procedure which will use a small number of poses. Statistical analysis of the joint excursions and end effector position variation in both "good" and "bad" subsets of poses were conducted. No significant statistical differences between them was discovered. The condition number of the Jacobian matrix is investigated as a potential measure of the accuracy which may be obtained from the subset under consideration. The condition number thus obtained contained too much variability to be a reliable predictor of accuracy. A computer simulation was conducted using a numerical optimizer to select the joint angles to be used for calibration. The optimizer studies failed to find an optimum set of poses for calibration. The conclusion of these studies is that there is no optimum set of poses to be used for calibration. An alternative hypothesis, that the resultant calibration accuracy depends only upon the accuracy of the measurements taken, seems to be proven.

CONTINUOUS MEASUREMENT BY EDDY CURRENT METHODS OF AGE HARDENING IN AN ALUMINUM ALLOY

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Many materials processing operations such as age hardening heat treatments typically involve following predetermined time and temperature schedules to obtain the desired final material properties. The intelligent processing approach is to develop sensors for monitoring of material response to processing operations in real time. As an alloy age hardens its electrical resistivity changes. Hence, the process of aging can be monitored by measuring the change in resistivity relative to that of a non-age hardening material such as fully annealed pure aluminum. A device using two small, spiral-wound probes was designed and used to induce eddy currents within the pure aluminum and the aging alloy. The probes were incorporated as elements in an impedance bridge circuit. The bridge unbalance voltage decreased in value over time indicating decreasing resistivity during the aging process. The monitoring concept was verified. Refinements such as improved impedance bridge circuitry and probe size/test frequency optimization are needed to unlock its full potential.

NONLINEAR DYNAMIC RESPONSE OF CYLINDRICAL SHELLS SUBJECTED TO UNDERWATER SIDE-ON EXPLOSIONS

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Two studies were performed to enhance the understanding of phenomena occurring in shell structures subjected to side-on underwater explosions. In the first, a numerical analysis was performed to investigate the non-linear response of cylindrical shells subjected to near-field side-on underwater explosions. In the second study, a numerical analysis of a cylindrical shell subjected to a far-field underwater explosion was compared with the results from an underwater explosion test. Sensitivity analyses were performed to determine the relative importance of various physical and numerical modelling factors.

OPTIMAL STOCHASTIC SLIDING MODE CONTROL OF UNDERWAY REPLENISHMENT IN A RANDOM SEA

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Motion control of underway replenishment operations is achieved through the use of sliding mode control with a Linear Quadratic Gaussian compensator design. External disturbances include first-order wave force and moment as well as slowly varying interaction forces and moments between the two ships. Feedback control is used to provide adequate stability of motions while feedforward control with disturbance estimation and compensation achieves the desired steady state accuracy. The results demonstrate that satisfactory path keeping during operations can be maintained for various ship proximity distances and environmental conditions.

COMPUTATIONAL UNSTEADY FLOW DYNAMICS: OSCILLATING FLOW ABOUT A CIRCULAR CYLINDER

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Master of Science in Mechanical Engineering-December 1991
Advisor: Turgut Sarpkaya-Department of Mechanical Engineering

The numerical experiments, carried out through the use of the vorticity-stream function equations and their finite difference form, on co-existing flows (sinusoidal or non-sinusoidal oscillation plus steady mean flow) are described. A third-order in time, second-order in space, three-level predictor-corrector finite-difference scheme has been used. The Poisson equation for the stream function was solved by a Fast Poisson Solver based on the High Order Difference Approximation with Identity Expansion (HODIE) and the Fast Fourier Transform (FFT) methods provided by the IMSL mathematical library. The results have revealed, for the first time, the existence of a very interesting wake comprised of three rows of heterostrophic vortices at certain Keulegan-Carpenter numbers and relative current ratios. The existence of such a street has been vindicated by physical experiments.

EXPERIMENTAL DEVELOPMENT OF TUBESIDE HEAT TRANSFER CORRELATIONS FOR LAMINAR FLOW WITH AND WITHOUT INSERTS

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Master of Science in Mechanical Engineering-September 1992
Advisors: Paul J. Marto & Stephen B. Memory-Department of Mechanical Engineering

An experimental study of laminar flow heat transfer of an ethylene glycol/water mixture in an electrically heated horizontal tube using wire mesh (HEATEX) and twisted tape inserts was investigated. Twelve thermocouples, inserted in the tube wall at four longitudinal locations, enabled a mean inside experimental heat-transfer coefficient to be accurately measured. A constant wall heat flux boundary condition was placed on the wall by wrapping six 200 W flexible heater tapes tightly around the tube. The ethylene glycol/water mixture provided a coolant Reynolds number between 200-5000 and a Prandtl number between 30-140. Two smooth inside diameters and a roped tube profile were tested with and without the inserts. Heat-transfer correlations for tubes without inserts were developed and compared with theory for both thermally and hydrodynamically developing flow. Correlations were also developed for the two types of inserts. Nusselt numbers for fully developed flow were found to be a function of Reynolds and Prandtl numbers for the wire mesh insert and a function of tape twist ratio, Reynolds and Prandtl numbers for the twisted tape insert. Heat transfer enhancements of over 7 for the wire mesh insert and over 4 for the twisted tape insert at high Reynolds numbers were obtained over the empty tube. By using these correlations in conjunction with earlier obtained refrigerant condensation data (using the same tubes, inserts, and coolant), more accurate values of the outside condensation heat-transfer coefficients were obtained.

NUCLEATE POOL BOILING PERFORMANCE OF R-114/OIL MIXTURES IN A SMALL ENHANCED TUBE BUNDLE

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Heat transfer tests were carried out using a small tube bundle of Turbo-B tubes in a pool of different R-114/oil mixtures. By accurately instrumenting five tubes within the bundle, both the convective and nucleate boiling regions were studied in detail, with emphasis on the 'bundle effect' (i.e., the effect of the lower tubes in operation on the upper tubes within the bundle). In addition, the influence of increased amounts of oil on the tube bundle was studied to see how this affected the overall heat transfer and in particular, the shape of the hysteresis loop.

NATURAL CONVECTION FROM A HORIZONTAL HEATER IN RESPONSE TO STEADY AND PULSATILE INPUT POWERS

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Advisor: Yogendra Joshi-Department of Mechanical Engineering

Natural convection heat transfer from a flush mounted heater on a larger horizontal substrate in water has been investigated for both steady and periodic input powers. For steady power conditions, the heat flux was varied from 222 to 6880 W/m^2. Heater surface temperatures were measured at several locations in order to develop a non-dimensional heat transfer correlation. Three types of periodic input powers were tested: a triangular wave, an approximate square wave, and a sinusoidal wave. Mean, amplitude, and frequency were varied for each wave. Temperature measurements at selected heater locations were compared with steady state conditions to determine heat transfer enhancement.

HEAT TRANSFER, ADIABATIC EFFECTIVENESS AND INJECTANT DISTRIBUTIONS DOWNSTREAM OF SINGLE ROWS AND TWO STAGGERED ROWS OF FILM-COOLING HOLES WITH SIMPLE AND COMPOUND ANGLES

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Experimental results for two compound angle injection systems (configurations 1 and 3), and for a simple injection system (configuration 2) are compared in this thesis. The effects of blowing ratio, spanwise hole spacing, hole angle orientation, and streamwise position (x/d) are discussed in reference to measurements of spanwise-averaged adiabatic effectiveness, iso-energetic Stanton number, and Stanton number Θ approximately equal to 1.5 obtained downstream of both one row of holes and two staggered rows of holes. Results indicate that effectiveness depends mostly on four parameters: simple or compound angle injection, spanwise hole spacing, one or two rows of holes, and blowing ratio. Results show that for a specified blowing ratio, for all configurations tested to date, spanwise-averaged adiabatic effectiveness is greatest at lower x/d values but decreases with streamwise development as the injectant is convected downstream. The rate of spanwise-averaged adiabatic effectiveness decrease is dependent on the blowing ratio, and mostly a result of lift-off of the injectant from the test surface at x/d values less than about 20. At larger x/d, spanwise-averaged adiabatic effectiveness values generally increase with blowing ratio mostly because of greater amounts of injectant along the test surface. Results also show that the iso-energetic Stanton number ratio lies between 1 and 1.35 for all cases studied and generally increases with blowing ratio for a given x/d.

X-RAY DIFFRACTION AND ELECTRON MICROSCOPE STUDIES OF YTTRIA STABILIZED ZIRCONIA (YSZ) CERAMIC COATINGS EXPOSED TO VANADIA

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The U.S. Navy sometimes has the requirement to use low cost fuels containing significant amounts of vanadium and sulfur in gas turbine engines. Unfortunately the yttria stabilized zirconia (YSZ) which is used as a thermal barrier coating on gas turbine blades can be severely attacked by vanadia. Powders of YSZ containing 8-mol% Y_2O_3 and pure zirconia containing various amounts of V_2O_5 were annealed at 900°C. These were then examined by X-ray diffraction and electron microscopy, as well as single crystals of pure ZrO_2 and YSZ (20%wt Y_2O_3) exposed to V_2O_5 melts, to study how the vanadium degrades the YSZ by reacting with the stabilizer to form YVO_4 and how the vanadia transforms the cubic and tetragonal YSZ crystal structures to monoclinic which degrades rapidly as a gas turbine blade coating.

THE INFLUENCE OF A LOWER HEATED TUBE ON NUCLEATE POOL BOILING FROM A HORIZONTAL TUBE

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Nucleate pool boiling is an essential part of the vast cooling systems today's combatant ship combat systems are dependent upon. Understanding the mechanisms that influence heat transfer in tube bundles in a liquid pool is the stepping stone for improving these cooling systems. This thesis attempts to bridge the gap between single tube performance and bundle performance by studying the effect of a lower heated tube on the heat transfer from an upper tube in a simple two tube bundle. This study concludes that a nucleating lower tube (regardless of the spacings tested between tubes) has a significant positive (i.e., improvement of heat transfer) influence upon upper tube. This is especially evident for a smooth tube where any hysteresis effects are completely eliminated when the lower tube nucleates at a heat flux of 10 kW/m^2 or greater. Furthermore, the only influence for the pitch-to-diameter ratios tested was at the highest heat fluxes for the smooth tubes where a p/d of 1.8 was found to give the maximum heat transfer. No such maximum was obtained for the enhanced tubes.

EFFECTS OF POWER PULSATIONS ON NATURAL CONVECTION FROM DISCRETE HEAT SOURCES

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The natural convection heat transfer response of an array of heaters flush mounted on a vertical test surface in water to periodic input power has been investigated. Two types of periodic input power variations were examined: a triangular wave and an approximate square wave. The resulting heater temperatures over several cycles were measured for mean values of 0.5, 1.0, 2.0, and 3.0 watts and varying amplitudes. The frequency of the input power pattern was also varied, from 0.025 to 0.1 Hz. The measured heater temperatures were compared with the responses for steady input power equal to the mean of the periodic input.

COUPLED ROLL AND DIRECTIONAL STABILITY CHARACTERISTICS OF SURFACE SHIPS

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The problem of roll, sway and yaw motions of surface ships is considered. A mathematical model is developed which consists of the nonlinear maneuvering equations and incorporates cross coupling between sway force, yaw moment and the roll angle induced during a steady turn. The hydrodynamic derivatives and coefficients of a typical container ship were used as the base-line study model. The coupled system of nonlinear algebraic equations is formulated and solved to predict the steady state roll angle, sway velocity and turning rate as a function of the rudder angle. The results are then compared to that of the decoupled systems currently employed. A local perturbation is implemented in the vicinity of the above steady states to investigate dynamic stability of motion. Sensitivity analysis with respect to important design parameters such as speed loss during turning, approach speed, transverse metacentric height and trim is performed. Results demonstrate the significance of the coupling between roll, sway and yaw and the need to incorporate similar studies in the ship design and analysis process.

NUMERICAL ANALYSIS OF OSCILLATING FLOW ABOUT A CIRCULAR CYLINDER

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The numerical experiments, carried out through the use of the vorticity-stream function equations and their finite difference form, on sinusoidally-oscillating as well as co-existing flows (sinusoidal oscillation plus steady mean flow) at low and intermediate Keulegan-Carpenter numbers are described. A third-order in time, second-order in space, three level predictor-corrector finite difference scheme has been used. The Poisson equation for the stream function was solved by a Fast Poisson Solver based on the High Order Difference Approximation with Identity Expansion (HODIE) and the Fast Fourier Transform (FFT) methods provided by the National Center for Atmospheric Research for the solution of separable elliptic partial differential equations with a non-square grid. The analysis has produced force transfer and fluid damping coefficients comparable to those obtained experimentally for both types of flows (i.e., with and without current) and to those obtained with a square grid through the use of the IMSL library.

CORRELATION OF PROCESSING, MICROSTRUCTURE AND SUPERPLASTICITY IN AN AL-MG-ZR ALLOY

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Investigation of the influence of the strain history during thermomechanical processing of an Al-10Mg-0.1Zr was conducted. Refined, recrystallized microstructures resulted when larger strains were employed in the later passes of the TMP. Superplastic responses up to approximately 420 percent were obtained. Conversely, when smaller strains were at the later stages of the TMP, less recrystallized, coarser structures resulted, and the corresponding superplastic ductilities of approximately 280 percent were obtained.

COMPUTER SIMULATION OF RANDOM AND NON-RANDOM SECOND-PHASE PARTICLE DISTRIBUTIONS FOR BOTH CONSTANT AND VARYING PARTICLE SIZE

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Mechanical properties of two phase materials, such as strength, ductility and toughness, depend on the size and distribution of the second phase. However, no methods are presently available to accurately quantify the homogeneity of the distribution of the second phase. Random and non-random second phase particle distributions have been simulated by computer and analyzed for various area fractions. Distributions of particles with a lognormal size distribution have been analyzed as well. A statistically sufficient number of particles for use in the model was determined and used for all simulations. Average first nearest neighbor spacing values for dilute arrays of particles approach those of Poisson distributions of infinitesimal points. As the particle density increases, the average spacing values approach those of hexagonal arrays. For low area fractions there is little distinction between random and non-random distributions, both from statistical and visual perspectives. For higher area fractions there is a discernable difference between the statistical data for random and non-random distributions, but the visual differences are more obvious. These observations hold for both constant size particles and particles with a lognormal size distribution.

PRECIPITATE COARSENING DURING OVERAGING OF 2519 AL-CU ALLOY: APPLICATION TO SUPERPLASTIC PROCESSING

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Overaging experiments have been conducted on a commercial grade 2519 Al-Cu alloy at a variety of temperatures and times, with and without prior induced strain. Hardness testing and scanning electron microscopy techniques were used to characterize evolution of microstructure during overaging. The further development of microstructure during thermomechanical processing by warm rolling was also assessed to determine whether the coarse particles produced by overaging could serve as sites for particle stimulated nucleation (PSN) of recrystallization. The thermomechanical processing methods have been shown to produce highly superplastic microstructures in Al-Mg and Al-Mg-Li alloys in previous work at NPS. Optical microscopy and tensile tests were conducted allowing a determination of the effect of the processing on the microstructural evolution and superplastic behavior of the Al-Cu material.

NATURAL CONVECTION IMMERSION COOLING OF AN ARRAY OF VERTICALLY ORIENTED HEATED PROTRUSIONS IN AN ENCLOSURE FILLED WITH A DIELECTRIC LIQUID: EFFECTS OF ENCLOSURE WIDTH, PRANDTL NUMBER AND COMPONENT ORIENTATION

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The natural convection heat transfer characteristics of a 3x3 array of vertically oriented heated protrusions, immersed in a dielectric liquid, were investigated. Aluminum blocks, 24mm x 8mm x 6mm, were used to simulate 20 pin dual in-line packages. Surface temperature measurements of the components were made by imbedding copper-constantan thermocouples below the surface of each component face. A constant heat flux was provided to each component using an Inconel foil heating element. Power supplied to each component varied from 0.115W to 2.90W. The aluminum blocks were mounted on a plexiglass substrate to form a 3x3 array of simulated electronic components. The circuit board containing the components was placed in a rectangular, plexiglass enclosure with inner dimensions: L = 203.2mm H = 152.0mm W = 82.6mm, and a wall thickness of 25.4mm. The upper boundary was maintained at 10°C, while all other exterior surfaces were insulated. The chamber width, measured from the surface of the circuit board to the opposite, inner wall of the enclosure, was varied from 42mm to 7mm by inserting plexiglass spacers into the enclosure. Two dielectric liquids, FC-75 and FC-43, were used as working fluids. Non-dimensional data from this study was combined with the data obtained by Aytar (1991) for a horizontal component orientation, to develop an empirical correlation which predicts the Nusselt number as function of Rayleigh number, Prandtl number, component orientation and chamber width. This correlation was found to be accurate to within 11% of the original curve fit data. Heat transfer in FC-75 was found to occur mainly by convection arising from buoyancy forces, regardless of chamber width. Heat transfer in FC-43 was found to occur mainly by molecular diffusion for chamber widths of 11mm or greater, and by convection at a chamber width of 7mm. The maximum uncertainty in the Nusselt and Rayleigh numbers was 2.5%, based on a zeroth order uncertainty analysis, and occurred at the lowest power level, where the maximum uncertainty in the temperature measurements resided.

EFFECT OF THERMOMECHANICAL TREATMENTS ON THE AGING RESPONSE OF CENTRIFUGALLY CAST SILICON CARBIDE/ALUMINUM COMPOSITES

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Differential scanning calorimetry was conducted using centrifugally cast monolithic A356 aluminum material and 26 volume percent silicon carbide (SiC) particle reinforced A356 aluminum matrix composite material in as-cast, cast and rolled, and cast and extruded conditions. Electrical resistivity and matrix microhardness measurements during isothermal aging treatments were also conducted. The effects of thermomechanical processing and SiC particle additions on the mechanical properties and aging kinetics of the metastable phases in each material were studied.

ENHANCED CONDENSATION OF R-113 ON A SMALL BUNDLE OF HORIZONTAL TUBES

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Condensation of R-113 was studied using an evaporator/condenser test platform. The condenser section contained four horizontal tubes (nominal outer diameter 15.9 mm) forming a vertical in-line column with a pitch-to-diameter ratio of 2.25 and a condensing length of 1.2m. The condenser tubes could be operated either individually (i.e., as single tube apparatus) or as a small tube bundle. This allowed investigation of the effects of condensate inundation on different types of condenser tubes. Tubes tested were smooth copper tubes, copper/nickel KORODENSE roped tubes, KORODENSE tubes wrapped with wire, and copper/nickel finned tubes (26 fpi). The outside heat transfer coefficient, h_o, was calculated by experimentally determining the overall heat transfer coefficient, U_o, and then using a modified Wilson Plot procedure. Great care was taken to ensure the results were not vitiated by the presence of noncondensibles. Results obtained with the smooth copper tubes are in agreement with published data and verify satisfactory operation of the test platform. Furthermore, problems associated with the apparatus encountered by previous workers were successfully overcome. In comparison to the top smooth tubes, the copper/nickel top KORODENSE tube yielded about a 22% increase in h_o. When different diameters of wire were wrapped around the copper/nickel KORODENSE tubes, an optimum pitch-to-wire diameter of 7 was found yielding almost a 90% increase in h_o, compared to the top smooth tube. This marked increase is presumably due to surface tension effects thinning the condensate film. The copper/nickel finned tubes gave the best enhancement (approximately a 7 fold increase). Comparison of the data obtained from the top copper/nickel finned tubes agreed well with the model of Beatty and Katz. The effect of condensate inundation was to reduce h_o for the lower tubes compared to the top tube in the bundle. Comparison of h_o for the second tube compared to the top tube showed that the effects of condensate inundation are reduced most by wrapping the KORODENSE tubes with fine wire.

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF ULTRA LOW CARBON BAINITIC 100 TUNGSTEN INERT GAS MULTIPASS WELDMENTS

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The U.S. Navy has maintained a continuous research, development and certification program in HSLA and ULCB steels with the intent of someday totally replacing the HY steels now used in ship construction. A major advantage in using HSLA and ULCB steels is their increase in weldability over the HY steels which now require large amounts of preheating to prevent crack formation in the heat affected zone. Up until the present day, however, low carbon HSLA and ULCB steels have not been used with dedicated low carbon weld wire. In the present work an attempt was made to correlate the mechanical properties (tensile strength, yield strength and Charpy impact energy), chemical composition and microstructure of a series of autogenous multirun TIG welds on ULCB steels. It was found that good combinations of weld strength and toughness could be achieved with appropriate choice of weld metal chemistry and TIG welding power, but that there was a ceiling of about 2.0wt.% molybdenum which could be tolerated before weld metal embrittlement became evident.

FACTORS INFLUENCING THE MICROSTRUCTURAL AND MECHANICAL PROPERTIES OF ULCB STEEL WELDMENTS

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The U.S. Navy has maintained a continuous research, development and certification program in HSLA and ULCB steels as a replacement for the HY steels used in ship construction. The major benefit of the HSLA and ULCB steels stems from the relative ease of weldability as compared with the HY steels which require large amounts of preheating to prevent weld metal crack formation. This study focused on ULCB steel weldment mechanical properties which were shown to be largely dependent on the heat input and to a lesser extent the base plate composition, cover gas and nonmetallic inclusion composition and content. The heat input rate and subsequent cooling rate for the ULCB/ULCB steel weldments determined the degree of constitutional supercooling indicating a high heat input (large constitutional supercooling) resulted in a tough, finely grained macrostructure while the lower heat input (small constitutional supercooling) generated a weak, columnar/dendritic macrostructure. The utilization of HY-130 base metal resulted in increased carbon pickup in the fusion zone and consequently poorer mechanical properties. The use of a reactive cover gas markedly increased the inclusion density and promoted the formation of carbides producing the poorest overall mechanical properties. The majority of the nonmetallic inclusions identified were spherical, complex aluminum-silicates or manganese-aluminum-silicates. The presence of inclusions did not appear to be dominant in the nucleation of acicular ferrite or in controlling the microstructural development.

DYNAMIC STABILITY OF POSITIVELY BUOYANT SUBMERSIBLES: VERTICAL PLANE SOLUTIONS

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This thesis analyzes the dynamic stability of positively buoyant submersibles. Six degree-of-freedom equations of motion are used to compute steady state behavior with motion restricted to the vertical plane. Steady state solutions are analyzed for various conditions of buoyancy including changes in (1) the amount of excess buoyancy, (2) the location of the center of buoyancy, (3) the location of the center of gravity, as well as (4) the deflection of bow and stern planes. The equations of motion are then linearized around these steady state solutions to predict dynamic response in the vertical plane. The stability of each solution is determined by eigen value analysis. The study then expands the analysis to include all six degrees of freedom (i.e., include stability analysis in the horizontal plane). Finally, numerical integration methods are used to verify the results.

WEIGHT OPTIMUM ARCH STRUCTURES

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This investigation is concerned with the optimization of arch structures. The DOT optimization code is used to minimize the volume of arch structures which are constrained by limits on stress, design geometry, and section dimensions. Modeling the arch structure by a series of bar-beam elements, the finite element method is used to compute element stresses. The DOT optimization code selects section dimensions to prevent failure due to element stresses exceeding the material yield stress. Specifically, through coordinate transformations between local element coordinates and global system coordinates the element stiffness matrices transform into the global stiffness matrix. The resulting system matrix equations are then solved for the system degrees of freedom, that is, displacements and slopes. The system degrees of freedom, in turn, are transformed back to the element level to compute the internal forces and moments and hence, the stresses. Results are presented for a number of cases with regard to optimization scheme and stress analysis.

SIMULATION OF THE UNDERWATER NUCLEAR EXPLOSION AND ITS EFFECTS

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This research was conducted to enhance understanding of the use of high explosives to simulate the effects of a nuclear underwater explosion. A review of the known characteristics of the nuclear, spherical conventional, and tapered conventional underwater pressure-time histories illustrates the selection of the tapered charge to simulate the underwater nuclear explosion. Three areas of study were then pursued. The first compared the structural response resulting from attack by conventional and nuclear type pressure profiles, verifying the need to match duration as well as peak pressure when simulating the underwater nuclear explosion. The second employed finite element analysis to study the three dimensional shock generated by a tapered charge. Third, a computer program was written to couple an optimizer with an existing tapered charge pressure-profile generating code to improve the tapered charge design process.

NEURAL NETWORK BASED PROPULSION SYSTEM FAULT DIAGNOSTICS FOR THE NPS AUV II

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The use of artificial neural networks to provide a method of detecting and isolating impending failures in an autonomous underwater vehicle propulsion system has been studied. Two types of fault diagnostic systems, each capable of detecting different types of faults, were designed. The first system addresses the fault identification process by looking at the raw data available from system sensors. The second design processes sensor data with a Kalman filter before it is input to a neural network. The Kalman filter was designed to identify system parameters that characterize its dynamic response. These parameters serve as input to the network. This system is capable of fault detection, isolation, and severity level determination.

DYNAMIC RESPONSE AND FAILURE ANALYSIS OF ALUMINUM CYLINDERS SUBJECTED TO UNDERWATER EXPLOSION

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An underwater explosion test was conducted on two closed aluminum cylinders to provide physical results from a dynamic collapse. Axial and side-on attack geometries were investigated in this study. Both cylinders displayed numerous fractures and significant plastic deformation. Finite element models of the cylinders were developed to aid in physical understanding of the dynamic response. Sensitivity analyses of the model parameters were conducted to determine the optimum modeling method. A computer model with failure prediction capability was utilized to investigate the dynamic failure mechanism.

A CORRELATION OF WELDING SOLIDIFICATION PARAMETERS WITH WELD MACROSTRUCTURE

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A 3-D finite difference model simulating single pass autogenous welds was used to predict the temperature fields in HY-80 steel arc weldments at various powers and torch velocities. From the predicted temperature field, two important solidification parameters were calculated at the solid-liquid interface: temperature gradients and crystal growth velocities. These were correlated with the macrostructures observed in actual weldments. For purposes of model validation, the predicted and actual fusion zone sizes wee in agreement, as were the predicted time temperature curves compared to those measured with thermocouples embedded in the plate.

FILMWISE CONDENSATION OF STEAM ON HORIZONTAL WIRE-WRAPPED SMOOTH AND ROPED TITANIUM TUBES

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Filmwise condensation heat-transfer measurements were performed on horizontal smooth and roped titanium tubes using steam. The roped tubes were a commercially available tube (KORODENSE) with a nominal pitch of 7 mm. To further enhance the outside heat-transfer coefficient of both the smooth and roped tubes a wire was tightly wrapped around the tubes. To see the effect that the wire diameter and wire pitch had on the enhancement, 3 different wire diameters were used (nominal diameters of 0.5, 1.0, 1.6 mm) giving a range of wire pitch to wire diameter ratio of between 2 and 9. Tests were conducted under vacuum and atmospheric pressure conditions. The data reduction technique used the modified Wilson plot. Results obtained for the wire-wrapped smooth titanium tubes showed a maximum enhancement of 30% as compared to a smooth titanium tube. This was for a tube using a 0.5 mm wire diameter (P/D_w = 7.92), corresponding to a fraction of the tube covered by the wire of 12%. The LPD KORODENSE titanium tube showed an enhancement of 20% as compared to a smooth titanium tube for both atmospheric and vacuum pressures. The addition of wrapping a wire in the grooves of the LPD tube showed no further significant enhancement of the three wire diameters tested.

OPTIMIZATION OF AN INTERNALLY FINNED ROTATING HEAT PIPE

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A finite element formulation with linear triangular elements was used to solve the steady-state, two-dimensional conduction heat transfer equation in the condenser wall section of an internally finned rotating heat pipe. A FORTRAN program using this method was coupled with the ADS program for automated design of the internal heat pipe fin geometry to optimize heat transfer. An increase in surface area, which increases heat transfer, also increases the condensate level, which decreases heat transfer. The additional condensate level does not offset the advantage gained by the increased surface area. The investigation provided combinations of the fin half angle, number of fins, and fin height for an optimum design. Water is used as the working fluid and the heat pipe is constructed from copper.

REFERENCE PATH GENERATION AND TRACKING OF MARINE VEHICLES

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This thesis analyzes the problem of accurate path following for marine vehicles. The reference path is generated automatically through the use of a critically damped second order model. An appropriate shift in the time axis allows a smooth path with zero overshoot regardless of the initial conditions. Control design for the physical system is achieved through the use of optimum control and linear quadratic regulator techniques. Results are presented for general maneuvering scenarios in the horizontal plane and demonstrate the validity of the methods used in the research.

A STUDY OF FILM COOLING DOWNSTREAM OF ONE AND TWO ROWS OF HOLES ORIENTED IN SPANWISE/NORMAL PLANES

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Experimental results are presented which describe the development and structure of flow downstream of a single row and two staggered rows of film-cooling holes with compound angle orientation. With the configuration studied, holes are inclined at 90 degrees with respect to the test surface when projected into the streamwise/normal plane, and 30 degrees with respect to the test surface when projected into the spanwise/normal plane. Within each row, holes are spaced 6.0 hole diameter apart in the spanwise direction which gives 3.0d spacing between adjacent holes for the staggered row arrangement. Also presentedare plots showing the streamwise development of injectant distributions and streamwise development of mean velocity distributions. Spanwise average values of the adiabatic film-cooling effectiveness are generally greatest at low x/d and decrease with increasing x/d values for any given blowing ratio. Spanwise averaged effectiveness values decrease with blowing ratio for x/d less than 40 except for data for m=2.5. This trend generally reverses itself at higher x/d values. Spanwise averaged iso-energetic Stanton number ratios range between 1.0 and 1.5 and show little variation as x/d increases for each value of blowing ratio, however for each x/d, values increase with increasing blowing ratio.

THE ROLE OF PARTICLES IN RECRYSTALLIZATION OF A THERMOMECHANICALLY PROCESSED AL-MG ALLOY

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The microstructural evolution related to the superplastic response of an Al-10Mg-0.1Zr alloy during thermomechanical processing (TMP) was studied. The TMP had been accomplished in previous work and consisted of twelve rolling passes, with reheating between each pass, to a total strain of 2.5. Quantitative data including length, aspect ratio and area of precipitated ß-phase (Al_8Mg_5) particles were obtained using image analysis methods applied to the as-rolled conditions following passes 8, 10 and 12. The corresponding accumulated strains were 1.5, 2.0 and 2.6, respectively. Precipitation of the ß-phase is complete by pass 8 and the size as well as the size distribution remained essentially unchanged in the subsequent passes. A model for particle-simulated nucleation of recrystallization, which is based on thermodynamic considerations, is evaluated with respect to experimental data.

TEMPERATURE DISTRIBUTION AND THERMALLY INDUCED STRESSES IN ELECTRONIC PACKAGING

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This investigation is concerned with the steady state temperature and thermally induced stress distributions in electronic packages due to heat generated by the chip. Finite Element codes were employed to solve for the distribution of temperature and stresses within the package. Four parametric studies were undertaken to determine their effects on system behavior. The material study considered two chip and two solder materials and four substrate materials. Convective heat transfer was varied from 200 $W/m^{2\circ}C$ through $500W/m^{2\circ}$. In the geometric study, chip height to overall height was varied. The effect of package encapsulation was studied. Results are presented for both temperature and stress distributions at the solder interfaces.

THE EFFECTS OF THERMOMECHANICAL PROCESSING PARAMETERS ON ELEVATED-TEMPERATURE BEHAVIOR OF A 6061 AL-AL_2O_3 METAL MATRIX COMPOSITE

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The effects of thermomechanical processing parameters on the elevated temperature behavior of a 6061 Al-Al_2O_3 metal-matrix composite (MMC) have been studied. The same processing parameters were employed with unreinforced 6061 Al to provide a comparison. These materials were both thermomechanically processed at either 350°C or 500°C using two rolling schedules. Both schedules involved a constant strain per pass. Subsequent mechanical tests were conducted at temperatures 200 to 500°C and strain rates ranging from 6.7E-3 s^{-1} to 1.31E-1 s^{-1}. The materials processed at 500°C exhibited higher strength when compared to those processed at 350°C for deformation temperatures below 350°C. Materials stabilized by annealing after completion of rolling displayed higher ductilities when compared to the as-processed materials, especially at lower testing temperatures. The peak ductilities of the MMC's occurred at testing temperatures near the prior rolling temperatures. Solution treatment prior to rolling and additional strains during rolling in excess of 2.5 appeared to have no effect on strength or ductility.

FLOW VISUALIZATION STUDIES OF GEOMETRIC EFFECTS ON WELD POOL STIRRING IN GAS TUNGSTEN ARC WELDS

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Flow visualization of geometric effects on weld pool stirring in GTA welds is presented using pulsed nitrogen laser vision system. Weld pool electromagnetic stirring is eliminated in HY-80 steel by the use of symmetric current flow path geometry. Laminar radial surface pulses are observed at low currents in stationary welds while flows of turbulent nature are observed at higher currents. Asymmetric welds in 6061 aluminum plate are also studied to determine surface flow characteristics and weld pool growth rates. Clockwise stirring is noted in stationary welds in conjunction with a vertical motion at the center of the pool. Solidified weld zone exhibits a profound crater that was not present in welds on HY-80 steel.

MICROSTRUCTURE-CRYOGENIC BEHAVIOR CORRELATIONS IN AL-CU-LI ALLOYS

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Welded panels of three chemistries of Al-Cu-Li alloy Weldalite™ were provided by Martin Marietta Manned Space Systems, after welding by Variable Polarity Plasma Arc (VPPA) technique with 2319 filler alloy. These alloys are being evaluated for production of the Space Shuttle External Tank - a large welded cryogenic structure. The materials were examined to determine the grain morphology and distribution of second phases in and near the fusion zone. Equiaxed grains were observed along the fusion zone boundary. Many of the equiaxed grain boundaries contained continuous second phase particles, and electron diffraction data showed these to consist of several unreported phases and T_B (Al_7Cu_4Li). Morphologically similar particles were observed on some boundaries in the heat-affected zone. Both the number of equiaxed grains and amount of second phase appear to increase as the copper and lithium contents increase. Slow three-point bend tests were performed at 77 K and interrupted at the onset of fracture. Metallographic sections of these samples were used to establish crack paths. The most common failure modes involved fracture along continuous grain boundary phase in the equiaxed grain region, but failure was also observed along certain grain boundaries in the fusion zone and heat-affected zone.

EFFECTS OF INTERFACIAL DEBONDING AND FIBER BREAKAGE ON STATIC AND DYNAMIC BUCKLING OF FIBERS EMBEDDED IN MATRICES

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Analyses were performed for static and dynamic buckling of a continuous fiber embedded in a matrix in order to determine the effects of interfacial debonding and fiber breakage on the critical buckling load and the domain of instability. A beam on elastic foundation model was used for the study. The study showed that a local interfacial debonding between a fiber and a surrounding matrix resulted in an increase of the wavelength of the buckling mode. An increase of the wavelength yielded a decrease of the static buckling load and lowered the dynamic instability domain. In general, the effect of a partial or complete interfacial debonding was more significant on the domain of dynamic instability than on the effects of static buckling load. For dynamic buckling of a fiber, a local debonding of size 10 to 20 percent of the fiber length had the most important influence on the domains of dynamic instability regardless of the location of debonding and the boundary conditions of the fiber. For static buckling, the location of a local debonding was critical to a free-simply supported fiber but not to a fiber with both ends simply supported. Fiber breakage also lowered the critical buckling load significantly.

VEHICLE GUIDANCE AND CONTROL ALONG CIRCULAR TRAJECTORIES

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The problem of path keeping of marine vehicles along curved paths is considered. In particular, we are concerned with circular arcs that join two consecutive straight line segments. This provides smooth path changes between one segment and the next utilizing a purely geometric reference path construction. Pure pursuit guidance is coupled with orientation angle control law to ensure stability and accuracy. Sensitivity analysis with respect to inaccuracies in the knowledge of the vehicle hydrodynamic characteristics is performed. The results demonstrate the validity of this approach and offer a way to achieve accurate path keeping in confined spaces.

AN ENERGY ANALYSIS OF THE PSEUDO WIGNER-VILLE DISTRIBUTION IN SUPPORT OF MACHINERY MONITORING AND DIAGNOSTICS

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The Pseudo Wigner-Ville Distribution is a signal transformation of an input time signal into a joint time-frequency domain, that provides an excellent characterization of an input signal as well as it's respective energy content. A smoothing window and energy sensitivity analysis of the discretized Pseudo Wigner-Ville Distribution is presented along with a machinery monitoring application using the resulting Wigner-Ville energy of the sampled signal. The ability to apply the Pseudo Wigner-Ville Distribution to both steady-state and transient machinery may enable the monitoring and diagnostics of virtually any piece of equipment.

PREPARATION OF EXTINCTION FREE γ TI-51AT.%AL ALLOY POWDER AND CHARACTERIZATION BY X-RAY DIFFRACTION

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The lattice parameters, structure factors, and Debye-Waller temperature factor of a homogenized, binary Ti-51at.%Al intermetallic alloy were determined using powder X-ray diffraction (XRD). Previous studies have been hampered by extinction at low Bragg angles, therefore improved powdering methods were implemented. The powder was produced by pulverizing lathe turnings taken from the sample ingot using a ceramic mortar and pestle. Then the powder was passed through a U.S. Standard #400 sieve mesh (38μm). After further grinding a new acoustical sieving procedure was performed where powder particle were passed through a 2000 line per inch sieve mesh (5-7μm). Next the powder was annealed to relieve the induced stress produced during grinding. An X-ray diffraction study was conducted for Bragg angles 10-140°. The $L1_0$ structured TiAl lattice parameters of $a_o = 4.002$Å and $c_o = 4.081$Å were determined using XRD peak positions. The resulting c/a ratio equalled 1.02. The measured integrated intensities of the Fundamental reflections were used to determine a Debye-Waller temperature factor of $B = 0.65$Å^2 using the Wilson Method. These values were determined to be accurate based on comparison to previous research and theoretical approximations. The effects of extinction at low Bragg angles were not completely avoided with the refined powder particle size; they were, however, significantly reduced.

MODELLING EXPERIMENTAL PROCEDURES FOR MANIPULATOR CALIBRATION

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A six degree of freedom manipulator, a PUMA 560, is calibrated using three different measurement systems in order to improve the accuracy of the manipulator. Closed loop kinematic chain modelling theory is presented. Variations in the models for each calibration method are presented. A simulation study is conducted to determine feasibility of the proposed methods. Experimental data is obtained and the actual calibration performed. A comparative analysis between both simulation and experiment and between measurement systems is performed. Various aspects regarding measurement system modelling are discussed. The calibrated kinematic parameters are presented as results.

FURTHER STUDIES IN FILMWISE CONDENSATION OF STEAM ON HORIZONTAL FINNED TUBES

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Over the years, there has been significant variation in the filmwise steam condensation data at NPS on horizontal low-integral finned tubes. With a view to increasing the accuracy of the data, inserts were used inside the tubes to reduce inside thermal resistance; however, significant discrepancies then occurred in the calculated outside coefficient when compared to data taken without an insert. These discrepancies arose due to the data reduction technique which assumes a known inside heat-transfer resistance and subtracts this from a measured overall resistance. If the assumed value on the inside is inaccurate, then the outside value is equally inaccurate. The present work uses an instrumented smooth tube to obtain accurate inside heat-transfer correlations both with and without inserts and uses these to obtain accurate outside coefficients for a family of uninstrumented finned tubes with a view to finding an optimum fin spacing for steam condensation.

MIXED AND FORCED CONVECTION FROM AN ARRAY OF DISCRETE HEAT SOURCES IN A VERTICAL CHANNEL

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Mixed and forced convection liquid cooling of discrete heat sources in a vertical channel was investigated. Ten heat sources were flush mounted to one of the plexiglass channel walls, while the opposite wall was insulated. Measurements of heater surface temperatures were made for a channel Reynolds number range of 500-7300 and heat flux range of 510-2700 W/m^2. Temperature patterns on the heated surface were visualized using liquid crystals. Effects of flow pulsations on heat transfer were also investigated in the 0-1.25 Hz range.

FORCE OVERRIDE RATE CONTROLLER FOR REMOTE ACTUATION

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Many remotely operated robotic manipulator systems are operated in rate control mode to achieve a commanded position and orientation of the end-effector. Performance of certain tasks, such as applying a torque to a screw, would be more efficient if performed in unilateral force control mode. A six axis force-torque model was developed to determine the required number and positioning of sensors and using force sensing resistors, a prototype force-torque transducer was built for testing. Using a force error signal, individual manipulator joint angles may be computed in an algorithm to achieve force replication in the end-effector.

NATURAL CONVECTION HEAT TRANSFER STUDIES OF SIMULATED AND ACTUAL ELECTRONIC COMPONENTS USING DIELECTRIC LIQUIDS FOR IMMERSION COOLING

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Efficient cooling methods play a major role in the design of large mainframe computers. Current methods of chip generated heat removal are limiting the size and speed of future designs. This study further investigates direct immersion dielectric liquid cooling on both simulated and actual electronic components. The fluid FC-71 is used to complete a study on small heated aluminum blocks, and the fluids FC-71, FC-[illegible], and FC-75 are used in another study on actual electronic components. Empirical correlations for Nusselt number were developed which accounted for Rayleigh or Grashof number variations and the enclosure width.

NUMERICAL FIELD MODEL SIMULATION OF FIRE AND HEAT TRANSFER IN A RECTANGULAR COMPARTMENT

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Shipboard fires have been the bane of mariners since man's earliest attempts to sail the sea. Understanding the behavior of fire in an enclosed space, such as those found on today's modern seagoing vessels, will greatly enhance the mariner's ability to combat or prevent them. In a joint effort between the Naval Postgraduate School and the University of Notre Dame a computer code has been developed to model a full scale fire in a closed compartment. The code uses a finite volume formulation to obtain numerical solutions to the unsteady, three dimensional conservation equations of mass, momentum and energy. Included are the effects of turbulence, strong buoyancy, surface radiation and wall conduction. The code gives velocities, pressure, temperatures, and densities throughout the field. This thesis applies that computer code to the U.S. Navy's full scale fire test chamber at Naval Air Warfare Center, China lake, California. Advanced computer graphics techniques, including color contouring and three dimensional vector field plotting have been applied to make output data more informative. It is hoped that someday this model could provide a useful tool for naval architects in the design of a fire safe ship, and a cost effective means for development/evaluation of new firefighting equipment and techniques.

PHASE TRANSFORMATIONS IN Ti_3AL BASED ALLOY

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A 'super α_2' Ti_3Al based alloy with additions of niobium, chromium and tantalum was studied with respect to phase transformations under different heat treatments and aging times and temperatures. As received samples were heated at temperatures ranging between 1000°C and 1300°C and quenched to retain the high temperature microstructure. Quenched samples were aged between 500°C and 850°C for various times and transformations were studied using dilatometry, x-ray analysis, transmission electron microscopy and microhardness testing. It was found that at around 650°C the transformation of $\beta \rightarrow \alpha_2$ occurred after two hours of aging, while below this temperature, aging for up to 100 hours at 500°C produced on the $\beta \rightarrow \omega$ transformation with very little α_2. Also, an ' ω -type' phase was observed at this aging temperature. Microhardness measurements ay diffraction confirmed the above results. Quenching from high temperature showed the presence of .. ike features which were poor in Ta and Cr and had the B2 structure. Finally, some regions with an orthorhombic structure were observed in the as quenched samples. Overall, peak hardness was obtained after aging the quenched ß phase sample at 650°C. This corresponded to a microstructure of retained ß with a fine acicular structure of α_2.

EFFECTS OF POSITIONAL INFORMATION TIME LAGS ON MOTION STABILITY OF AUTONOMOUS VEHICLES

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Highly maneuverable ocean going vehicles require quick response, control, and guidance to maintain accurate track keeping characteristics. Ocean vehicles, however, may experience significant lags in their inertial positional information that limit their reaction times. This thesis investigates the effects of these lags on guidance and control. The relationship of critical visibility versus the controller time constant and its effect on the stability of the guidance/control scheme is analyzed. Results are presented based on time domain and frequency response techniques using a dynamic model of the Naval Postgraduate School Autonomous Underwater Vehicle II (NPS AUV II), for which a complete set of hydrodynamic coefficients and geometric properties is available.

DESIGN, SIMULATION, AND EXPERIMENTAL VERIFICATION OF A COMPUTER MODEL AND ENHANCED POSITION ESTIMATOR FOR THE NPS AUV II

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A full six-degree-of-freedom computer model of the Naval Postgraduate School Autonomous Underwater Vehicle (NPS AUV II) is developed. Hydrodynamic Coefficients are determined by geometric similarity with an existing swimmer delivery vehicle and analysis of initial open loop AUV II trails. Comparisons between simulated and experimental results demonstrate the validity of the model and the techniques used. A reduced order observer of lateral velocity was produced to provide an input for an enhanced position estimator. Results are presented which show that the position estimator can be calibrated using AUV II run data to provide a real-time accurate estimate of position.

THERMAL CYCLING BEHAVIOR OF UNIDIRECTIONAL AND CROSS-PLIED P100 GR/6061 ALUMINUM COMPOSITES

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The thermal strain response of as-cast samples of 40% P100 graphite fiber reinforced 6061 Al composites in the unidirectionally reinforced and the [0/90] cross-plied configuration was studied. Thermal strain hysteresis and residual plastic strain were observed, both changing with continued cycling. The compressive residual plastic strain is attributable primarily to creep deformation due to compressive residual stress in the matrix at elevated temperature. The role of matrix creep in the heating rate dependence of the strain response was studied by measuring strains under isothermal conditions in the absence of applied stresses. Damage mechanisms operative in the composites during thermal cycling, and the impact of ply constraint on the strain response were also evaluated.

HEAT TRANSFER, ADIABATIC EFFECTIVENESS AND INJECTANT DISTRIBUTIONS DOWNSTREAM OF SINGLE AND DOUBLE ROWS OF FILM-COOLING HOLES WITH COMPOUND ANGLES

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Experimental results are presented which describe the development and structure of flow downstream of one row and downstream of two staggered rows of film-cooling holes with compound angle orientations. Results presented include distributions of iso-energetic Stanton number ratios, and adiabatic film-cooling effectiveness deduced from Stanton numbers using superposition. Also presented are plots showing the streamwise development of injectant distributions and streamwise development of mean velocity distributions. Spanwise averaged values of the adiabatic film-cooling effectiveness are highest for blowing ratio m=0.5 and decrease as blowing ratio increases for x/d less than 20. At farther downstream positions, spanwise averaged effectiveness values increase with blowing ratio, except for data obtained downstream of two rows of holes with a blowing ration of 3.0 and data obtained downstream of two rows of holes with a blowing ratio of 3.0 and data obtained downstream of one row of holes with a blowing ratio of 4.0, where severe lift-off of injectant occurs. Spanwise averaged iso-energetic Stanton number ratios range between 1.0 and 1.4 and show little variation as x/d increases for each value of blowing ratio, however for each x/d, values increase with increasing blowing ratio.

WEIGHT OPTIMUM ARCH STRUCTURES

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The goal of this investigation is to design minimum weight arch structures which span the distance between two points in two-dimensional space. An arch of unknown shape and variable cross-sectional width is modeled as a series of straight bar-beam elements. Finite Element Methods are used to compute the stresses in each element. Automated Design Syntheses (ADS) software is then used to vary the slope of each element and the cross-sectional width to prevent the yield stress of the material from being exceeded as ADS minimizes the arch volume to arrive at the minimum weight structure. Results are presented for a number of different loadings and boundary conditions.

A STUDY OF THE MICROSTRUCTURAL BASIS FOR THE STRENGTH AND TOUGHNESS PROPERTIES OF AS-QUENCED AND QUENCED AND TEMPERED HIGH COPPER HSLA-100 STEEL

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A program for the use of high copper HSLA-100 steel as a replacement for HY-130 in ship construction is in progress at the David Taylor Naval Research Center in Annapolis, Maryland. The characterization of the microstructure of this highly weldable high copper HSAL-100 steel is extremely important to this program. In the present work, optical, scanning electron and transmission electron microscopy were employed to analyze and characterize the microstructural basis for the mechanical properties off as-quenched and quenched and tempered high copper HSLA-100 steel in the form of 19.05 mm plate. The as-quenched and samples aged at 538°C and 621°C were examined in great detail. In the as-quenched condition the microstructure consisted of small packets of highly dislocated lath martensite containing autotempered Fe_3C carbides with small amounts of retained austenite present as then films (200-300 Å in width) at lath boundaries. The basis for the high strength and toughness of this as-quenched sample is the small transformation product packet size and the highly dislocated structure. The best combination of strength and toughness occurred in the sample aged at 538°C. Contributing to these desirable characteristics was the recovery of the dislocation substructures, the precipitation of coherent BCC copper precipitates (12-20 Å in size) further precipitation $(FeM)_3C$ carbides and the small transformation product packet size. In the overaged (621°C) condition, the toughness was increased and the strength decreased due to the absence of coherent BCC copper precipitates and the presence of FCC ϵ-copper incoherent precipitates. Further recovery of the dislocation substructures was also evident. All of the samples (lot GLB) studied met the MILSPEC for HY-130 and would be suitable replacements. As a result of this investigation it is suggested that the optimum aging temperature for the 19.05 mm as-quenched high copper HSLA-100 plate is around 550°C.

MASTER OF SCIENCE
IN
METEOROLOGY

MULTISPECTRAL ANALYSIS OF MARITIME CLOUDS AT NIGHT IN THE PRESENCE OF ATMOSPHERIC WATER VAPOR

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Multispectral analysis methods are exercised using AVHRR channels 3, 4, and 5 to improve upon single-wavelength thermal imagery at night. An algorithm was developed yielding cloud location and water vapor distribution from channel 3-4 and 4-5 differences, respectively. Water vapor effects on pixel registration for cloud were examined using two candidate subscenes, one cloudy and dry, the other, cloudy and moist. A positive water vapor/cloud-free correlation was found using statistical techniques on the candidate subscene scatter plots. TOVS water vapor channels verified the analyzed water vapor pattern in the 4-5 difference image. V-shaped cloud/clear thresholds were applied to various subscene scatter plots to account for the positive correlation of water vapor-to-cloud registration. Results showed that in regions of higher water vapor concentrations, pixels nearest cloud boundaries were likeliest to be misclassified as clear. Images containing significant water vapor gradients and cloud variations required threshold refinement for best results.

TESTS OF A CONVECTIVE CLOUD MODEL WITH SOUNDINGS DURING THE TCM-90 FIELD EXPERIMENT

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A new proposed scheme for representing cumulus convection in a large-scale numerical model has been tested using the dataset collected during the Tropical Cyclone Motion (TCM-90) field experiment. This new scheme incorporated some modifications by K. Emanuel, which are based on recent observations of convective clouds, and showed much of the vertical transport of convective clouds was accomplished by subcloud-scale drafts rather than by the clouds themselves. These small-scale drafts were idealized and regarded as the fundamental agents of the convective transport. The input to the idealized model of subcloud-scale updrafts and downdrafts is the one-dimensional arrays of temperature and mixing ratio as a function of pressure, and the output is the tendency of potential temperature and the tendency of mixing ratio as well as the rate of convective precipitation. In this test, 46 dropwindsondes from the TCM-90 dataset with vertical resolution of 10 mb were chosen as inputs. The convection scheme is integrated in time to investigate the outputs of precipitation rates. The model was forced with constant radiative cooling, convective heating/and moistening calculated from model and surface fluxes in all cases. We conclude that this new modified convective scheme predicts quite reasonable precipitation rates in the regions beyond 4° latitude radius, but not near the center (too small) of Supertyphoon Flo on 16, 17 and 18 September 1990.

MASTER OF SCIENCE
IN
METEOROLOGY
AND
PHYSICAL OCEANOGRAPHY

OBSERVATIONS OF WIND FORCED CIRCULATION ON THE CONTINENTAL SHELF OFF POINT SUR, CALIFORNIA FROM A SELF-CONTAINED ACOUSTIC DOPPLER CURRENT PROFILER

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To study the current structure of the California Current as it manifests itself on the continental shelf a subsurface mooring, P1, was anchored 5 km west of Point Sur at 36° 17',N 121°59'W from 28 February through 11 May 1990. The P1 mooring, placed on the 84 m isobath, consisted of a Self-Contained Acoustic Doppler Current Profiler (SC-ADCP) housed in a syntactic foam sphere and secured to an anchor. The mooring geometry placed the transducer heads at 80 m depth. The instrument operated at 307 kHz with each beam inclined 30° from the vertical. An ensemble average of 170 one-second pings were recorded every 15 minutes for 70 days. Good velocity data to within 15 m of the surface were obtained at 4 m intervals throughout the record. Low-pass filtered data indicate high coherence between the observed currents and the local wind forcing measured at the Monterey Bay NOAA buoy 53 km to the northwest of P1. During equatorward wind events the current response was vertically sheared and time-lagged at depth with near surface speeds up to 35 cm s^{-1}. During wind relaxations (periods of no wind) and poleward winds a pressure induced barotropic poleward flow, on the order of 10 cm s^{-1}, developed throughout the water column. These poleward currents became more frequent and better developed later in the record. Analysis of adjusted sea level (ASL) differences between stations located to the north and south of mooring P1 suggest an increasing poleward pressure gradient during the span of the record. Alongshore differences in the alongshore wind stress component contributed to the increasing difference in ASL. A simple wind forced theoretical model, adapted from Ekman (1905) and Csanady (1982), was used to describe the flow in the coastal regime. The model consists of surface and bottom boundary layers superimposed on a mostly geostrophic interior flow driven by set-up and set-down of the sea surface near the coast. The magnitude, direction, and sense of rotation of the current vectors with depth were reproduced well by the model when it was forced by the actual magnitude of the surface wind stress and a realistic vertical eddy coefficient (A_z). Differences between the model and the observations can be accounted for by other elements of the coastal circulation not included in the model.

ESTIMATING MESOSCALE, OROGRAPHICALLY ENHANCED PRECIPITATION USING SYNOPTIC SCALE DATA

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A method for resolving the mesoscale distribution of precipitation over mountainous regions is developed using synoptic scale analyses and a 40 km resolution of topography. The method consists of calculating the saturated moisture flux at a level assumed to be the cloud base and correlating this quantity with observed precipitation. General correlation coefficients ranged from -0.2 under conditions poorly represented by the synoptic surface analysis to -0.55 when these analyses are more representative of actual forcing. When applied regionally, correlation improved dramatically, suggesting potential incorporation into precipitation forecasts over mountainous areas. Over wider regions of less defined topography correlation is weaker, but is still an improvement over the current synoptic scale precipitation forecast products.

EXAMINATION OF THREE-DIMENSIONAL (3-D) EFFECTS ON SOUND PROPAGATION THROUGH MESOSCALE FEATURES USING 3-D COUPLED MODE THEORY

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A study of the three dimensional (3-D) effects of mesoscale variability on underwater sound propagation is conducted by interfacing the Chiu-Ehret 3-D acoustic coupled mode (CM) model with a forecasted sound speed field generated by the Harvard Open Ocean Model (HOOM). This research concentrates on the sensitivity of the acoustic wave field to source depth and location with respect to a core ring in the Gulf Stream system for a 50 Hz sound source. The inclusion of the exact 3-D physics in acoustics modeling requires substantial computer resources. For this reason, it is very desirable to determine when the simpler adiabatic or Nx2-D approximations may be used. To achieve this goal, " exact" 3-D acoustic coupled mode model calculations are compared to results from the adiabatic approximation and the Nx2-D approximation in terms of transmission loss and phases and amplitudes of individual mode modulation envelopes. The results show that the accuracy of the adiabatic and Nx2-D approximations depend strongly on the radial and transverse sound speed gradients along the track and the acoustic quality considered.

DEFINITION OF MEAN ENVIRONMENTAL STEERING FLOW FOR TCM-90 TROPICAL CYCLONES

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A definition for the environmental steering flow in the vicinity of the TCM-90 tropical cyclones is sought by low-pass filtering the Naval Operational Global Atmospheric Prediction System deep-layer mean u- and v-velocity and geopotential height fields. One-dimensional and two-dimensional Fourier decompositions in a limited region (120° long) and in a global region are compared with six wavenumber low-pass filters (1-6, 1-9,..., 1-21). The measure of goodness of the environmental steering flow interpolated to the storm position was to determine the minimum standard deviations of the propagation vector (defined as difference between storm motion and the steering estimate) for all six storms and the ensemble. The best results were found for either the limited region and global one-dimensional Fourier analyses of the u and v wind fields with a low-pass filter that included only wavenumbers 1 - 15. The six TCM-90 tropical cyclones were subsequently analyzed using this definition of the steering flow to estimate the propagation vectors and to examine the linear shear and relative vorticity gradients of the environmental flow. Except for early stages of storms in low latitudes, the low-pass filtered analyses provided steering vectors consistent with the changing translation directions. However, the translation speeds tended to exceed the storm motion and lead to more westward propagation vectors than expected. These propagation vectors tended to be almost perpendicular to the absolute vorticity gradient vector.

EFFECTS OF WATER VAPOR AND ANISOTROPIC SCATTERING ON AEROSOL OPTICAL DEPTH RETRIEVAL

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NOAA-7 AVHRR data from April 1982 was used to perform global-scale analysis of aerosol particle characteristics. Mahony's (1991) water vapor correction was incorporated into the AVHRR multichannel satellite data processing technique used by Frost (1988). Channel 4/Channel 5 brightness temperature difference was used as an estimate of water vapor content in an air column. Greatest measured water vapor content was at the equator, decreasing toward the poles. Applying the correction reduced the aerosol particle size index, resulting in an increase in aerosol optical depths. In addition, the high particle size index over the low latitudes in the southern hemisphere noted by Frost, was reduced significantly after applying the correction. A comparison was made between Frost's values for the variable two-term Henyey-Greenstein phase function and those derived with the water vapor correction. The basic shape of the curve is similar to that determined by Frost.

SYNOPTIC AND MESOSCALE FACTORS INFLUENCING STRATUS AND FOG IN THE CENTRAL CALIFORNIA COASTAL REGION

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This study was done to describe the synoptic and mesoscale events associated with the development of fog and stratus along the Central California coast during the 30 April to 5 May 1990 period. These events were compared and contrasted to the synoptic and mesoscale evolution found for stratus surge and Catalina Eddy events. Based on the analysis, the formation of the stratus and fog was found to be initiated by the movement of an upper-level cut-off low and a short wave ridge. Their movements provided increased subsidence and upper-level NVA over Southern California, which, in turn, produced higher pressure over the Vandenburg region. This coupled with relatively lower pressure over Oakland, set up flow conditions that lead to the formation of the stratus and fog. The Vandenburg/Oakland pressure gradient produced southerly flow, which carried warm moist air over relatively cooler water. The moist air condensed and stratus and fog developed.

MULTI-FRACTAL ANALYSIS OF NOCTURNAL BOUNDARY LAYER TIME SERIES FROM THE BOULDER ATMOSPHERIC OBSERVATORY

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Time series from a nocturnal boundary layer are analyzed using fractal techniques. The behavior of the self-affine fractal dimension, D_A, is found to drop during a gravity wave train and rise with turbulence. D_A is proposed as a time series conditional sampling criterion for distinguishing waves from turbulence. Only weak correlations are found between D_A and bulk turbulence measures such as Brunt-Väisälä frequency, Richardson number, and buoyancy length. The advantages of D_A analysis over turbulent kinetic energy (TKE), its component variances, FFT spectra, and self-similar fractals are also discussed in terms of local versus global basis functions, dimensional suitability, noise, algorithmic complexity, and other factors. D_A was found to be the only measure capable of reliably distinguishing the wave from turbulence.

ANALYSIS OF SHIP TRACKS IN CLOUDINESS TRANSITION REGIONS

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The radiative and spatial characteristics of 63 ship tracks are analyzed in cloudiness transition regions using AVHRR satellite data. Channels 1, 2, 3, 4 and 5 are utilized to determine the variations in ship track albedo and temperature in three distinct cloud environments: stratus, broken stratus and cumulus. Stratus Tracks in a stratus environment are brightest with respect to broken stratus and cumulus tracks. Cumulus tracks have the highest percentage increase in albedo over their environment in Channel 1, while broken stratus tracks have the highest percentage change over their environment in Channel 3. There is little temperature difference between the ambient cloud and ship track in all three environments. Stratus track tend to be longer than either broken stratus of cumulus tracks. No significant difference in the width of the track was observed between the environments.

SHIPTRACK DETECTION ALGORITHM STUDY

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Shiptracks are known to be a relatively common phenomenon, often appearing in AVHRR channel 3 imagery as anomalous, curvilinear cloud lines. Despite their significance to remote ship surveillance studies, the formation mechanisms responsible for shiptrack production are still largely unknown and their specific characteristics still undefined. A shiptrack detection algorithm being developed at the Naval Postgraduate School seeks to objectively detect and locate shiptracks on AVHRR imagery. This algorithm is a major step in objectively defining specific shiptrack characteristics and automating the search for additional shiptrack examples. The purpose of this study was to outline the logic of the detection algorithm and present a subjective performance summary of its usefulness. After careful analysis of the algorithm output files on several full satellite passes, it was determined that the algorithm is capable of successfully detecting up to 65% of the fresh shiptracks within a full pass AVHRR image with a false detection rate of only 1.31 tracks per million square kilometers. This performance is likely to improve further with continued work focused on designing adequate filters to categorically reject many of the recurring false detections.

ANALYSIS OF A SIMULATION OF THE SEASONAL CYCLE IN THE TROPICAL PACIFIC OCEAN IN AN EDDY-RESOLVING GLOBAL OCEAN MODEL

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This paper examines the multi-level, primitive equation, global ocean circulation model of Semtner and Chervin for its ability to simulate the seasonal cycle in the tropical Pacific Ocean. The result of a 20-year integration of this model using annual mean wind forcing was reported in Semtner and Chervin(1988). This was the first global eddy-resolving ocean calculation and it showed many realistic features of ocean circulation. The phase of the simulation analyzed in this report incorporates seasonally varying wind forcing from the Hellerman and Rosenstein (1983) global data set. These wind stress values were defined on a grid with 2° spacing which have been interpolated to the one-half degree grid points of the Semtner and Chervin model. There is no interannual variability in the wind fields of this data set. The results presented here are from the fourth year of a 10-year seasonal cycle run. The upper oceanic circulation of the equatorial Pacific Ocean consists of alternating westward and eastward flows that vary seasonally in strength and extent. The eastward flows investigated in this study are the Equatorial Undercurrent and North Equatorial Countercurrent; the westward currents are the North and South Equatorial Currents. The Equatorial Undercurrent is most intense late in the Northern Hemisphere spring and is weak in the late fall at which time the North Equatorial Countercurrent and the South Equatorial Current are most intense. This result is in agreement with observations and other model studies.

EVALUATION OF THE NAVAL RESEARCH LABORATORY LIMITED AREA DYNAMICAL WEATHER PREDICTION MODEL: TOPOGRAPHIC AND COASTAL INFLUENCES ALONG THE WEST COAST OF THE UNITED STATES

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This paper describes the evaluation of the NRL Limited Area Dynamical Weather Prediction Model in simulating coastal atmospheric mesoscale phenomena along the west coast of the United States during the period 0000 UTC 02 May 1990 - 1200 UTC 03 May 1990. A graphical comparison technique is used. Model output was compared horizontally with large-scale analyses, station data, cross-section analyses, and vertical profiles at specific locations. The model successfully simulated the wind and temperature fields, but failed to accurately replicate moisture and height fields.

THE EFFECTS OF MIXED LAYER DYNAMICS ON ICE GROWTH IN THE CENTRAL ARCTIC

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The thermodynamic ice model of Thorndike (1992) is coupled to a one-dimensional, two-layer ocean entrainment model to study the effect of mixed layer dynamics on ice growth and the variation in the ocean heat flux into the ice due to mixed layer entrainment. Model simulations show (i) the existence of a negative feedback between the ice growth and the mixed layer entrainment; and (ii) the underlying ocean salinity has a greater effect on the ocean heat flux than does variations in the underlying ocean temperature. Model simulations for a variety of surface forcing and initial conditions demonstrate the need to include mixed layer dynamics for realistic ice prediction in the Arctic.

NUMERICAL STUDIES OF THE BETA-EFFECT IN TROPICAL CYCLONE MOTION USING A SEMI-LAGRANGIAN MODEL

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It has been found that the beta effect can have an important effect on tropical cyclones. To conduct an experimental study of tropical cyclone movement on a beta plane a numerical model was developed. This model is based on the barotropic vorticity equation and used a semi-Lagrangian technique for the advective terms. The basic model is studied for accuracy and efficiency. It is seen that the accuracy of the semi-Lagrangian scheme is very good at moderate grid intervals, 20 km to 40 km, producing a much smoother vorticity field than that produced by the finite difference model. The efficiency of the semi-Lagrangian scheme as the time interval was increased was not fully achieved due to the shear effect in this regional model. When the beta effect was added, the model predicted vortex tracks and beta gyres compared well with those obtained from the finite difference model with a 20 km grid size. However, the semi-Lagrangian forecast with a grid size of 10 km gave somewhat different track, which could not be explained.

HIGH FREQUENCY ANALYSES OF COASTAL METEOROLOGICAL PHENOMENA AFFECTING REFRACTIVITY

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An eastern Pacific Ocean survey was conducted 7-10 May 1991 along the California coast to determine temporal and spatial variability in refractive conditions. Refractive profiles obtained from high frequency radiosonde measurements at shore sites and a ship plus continuous shipboard surface measurements found a high degree of refractive variability to be present associated with frontal passage. Local and synoptic scale conditions were found to have a major impact on the degree of refractive variability. The variability was in the occurrence of elevated layers and the evaporation duct height. With passage of the cold front, the evaporation duct height increased from values that would not affect shipboard sensors to those that would. Survey soundings and refractive profiles were also compared with subjective refractive analyses and forecast profiles from the Navy Atmospheric Boundary Layer model. In situ measurements revealed significant variability in refractive profiles that were not revealed in the model forecasts.

COMPARISON OF AREAL EXTENT OF SNOW AS DETERMINED BY AVHRR AND SSM/I SATELLITE IMAGERY

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Advanced Very High Resolution Radiometric (AVHRR) and Special Sensor Microwave Imager (SSM/I) imagery are compared to determine the areal extent of snow. A multi-spectral AVHRR algorithm, utilizing channels 1 (0.63 μm), 2 (0.87 μm), 3 (3.7 μm) and 4 (11.0 μm), creates a synthetic image that classifies land, snow, water and clouds. The classified images created by this algorithm serve as a baseline for a second algorithm that examines spatially and temporally matched SSM/I imagery. The SSM/I separation algorithm uses the 85 GHz horizontally polarized channel as well as the 37 GHz horizontally and vertically polarized channels. The synthetic image created by this algorithm classifies land, snow and water. Both separation algorithms use empirically derived separation thresholds obtained from bi-spectral scatter plots. Separation is made at a given pixel location based on the radiative identity assigned to that location from various wavelength combinations. The AVHRR data provides high resolution, daytime images of the snow pack but is completely dependent on the absence of clouds to view this ground based feature. The SSM/I data gives lower resolution imagery of the snow during daylight or night time satellite passes and is not affected by the presence of non-precipitating clouds. A total of 12 sub scenes are analyzed using both data sets and general agreement of the two sets of imagery is established.

ANALYSIS OF DRIFTING SOFAR BUOYS IN THE GREENLAND SEA 1989-1990

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In an attempt to gain a better understanding of the intermediate depth circulation of the Greenland Sea, 16 SOFAR floats were launched into Fram Strait in 1988 and 1989. Between the fall of 1989 and the summer of 1990, five of these floats were tracked by autonomous listening stations (ALS) positioned to provide tracking in the southern portion of the Greenland Sea. One float (MZ86) provided tracking information for ten months of the ALS deployment period. The other floats provided tracking information ranging from several days to two months. These float tracks delineated the intermediate depth circulation around the Greenland Sea gyre. The MZ86 trajectory exited the Boreas Basin and crossed the Greenland Fracture Zone with a speed of approximately 17 cm s^{-1}. Along the Greenland continental slope the flow increased to 28 cm s^{-1} suggesting the presence of a bottom trapped boundary current. Near 74°N the trajectory turned eastward under the shallower warm core of the Jan Mayen Current at 4 cm s^{-1}. This leg closed the Greenland Sea gyre and also shows evidence of interactions with filaments of the Norwegian Atlantic Current (NAC) coming through the Mohns Ridge at these intermediate depths. Two other floats demonstrated tracks which crossed the Mohns Ridge and drifted farther to the east, mixing with the waters of the NAC.

IMPROVED AEROSOL OPTICAL DEPTH AND PARTICLE SIZE INDEX FROM SATELLITE DETECTED RADIANCE

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An algorithm that extracts aerosol optical depth and particle size index from satellite observations of upwelling radiance over clear ocean areas was modified and studied. In order to examine the algorithm's performance on a regional scale, a previously analyzed data set, retrieved by the NOAA-9 AVHRR sensor, was reprocessed. The area of the study was in the central Pacific Ocean during the RITS-88 cruise from 7 April to 5 May 1988. The results were compared to those of the earlier study and used to investigate changes caused by modifications to the algorithm. One significant modification was to account for the absorption of column water vapor in the calculations. In addition, the correlation between aerosol optical depth and the two-term Henyey-Greenstein phase function was investigated by normalizing measured radiance values. The results compared well with the earlier study and supported the modifications to the algorithm. Based on this study, aerosol optical depth was shown to be correlated to the Henyey-Greenstein phase function. This knowledge helped in formulating improvements to the phase function. It was concluded that satellite imaging and processing on a regional scale is a useful way to study marine aerosols, that results can be improved by considering the effects of atmospheric water vapor absorption and other modifications to the calculations, and that there is room for improvement to the two-term Henyey-Greenstein phase function.

SATELLITE DETECTION OF COMPLEX AEROSOLS OVER THE ARABIAN PENINSULA/GULF

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Master of Science in Meteorology and Physical Oceanography-March 1992
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Satellite detection of complex aerosols, in particular, oil smoke over water and dust over land, is generally difficult. On 1 March 1991, a smoke plume generated by burning Kuwaiti oil wells and a dust storm over the southwestern Arabian Peninsula, provide the opportunity to study both of these effects. Utilizing NOAA-11 AVHRR data, a two dimensional scatter plot analysis technique was employed to determine and classify the radiative signatures of the smoke and dust. A two dimensional mask routine was then used to assess the reliability of the scatter plot analyses and spatially display the results. A channel 1 to channel 2 radiance ratio versus a channel 4 brightness temperature combination provided the best separation of the smoke signature from water. The dust plume was unambiguously represented by channel 5 brightness temperature minus channel 4 brightness temperature image versus a channel 4 brightness temperature combination. Together the 2D scatter plot technique and 2D mask form the groundwork for a possible detection algorithm.

CONDITIONAL INSTABILITIES OF THE GREENLAND SEA

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This is an examination of the open ocean deep water formation process of the Greenland Sea and how it is effected by the depth dependent thermal expansion coefficient. It is hypothesized that free convection associated with parcel instability is possible because of the increase in the thermal expansion coefficient with pressure in conjunction with requisite ambient temperature and salinity profiles. Based on the depth dependence of the thermal expansion coefficient, a neutral profile model for parcel instability was formulated and the effects on mixed layer dynamics were investigated. In situ profiles for the wintertime Greenland Sea were examined for potential parcel instabilities. It was shown that only small surface salinity increases associated with freezing could lead to deep penetrative convection. Finally, an analysis was performed for regions of low stability using climatology from the Levitus data set to determine regions most likely for deep convection.

SURFACE METEOROLOGICAL PARAMETERS OF IDENTIFIED SHIP TRACKS

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Ships producing tracks in the atmosphere are identified and their surface meteorological parameters are specified. Thirteen case studies are presented with satellite imagery, synoptic discussion and surface meteorological parameters. A composite "environment" is derived from reported surface meteorological parameters and is compared with climatological conditions of the region, showing that significant departures from normal conditions do not occur. No clear generation mechanism is suggested in a relationship between relative wind and separation distance of ship and ship track, indicating a complex relationship of generation mechanisms. Although a limited study, a firm foundation is now in place for further research into ship track genesis.

UPPER-TROPOSPHERIC FORCING OF THE INTENSIFICATION RATES OF TROPICAL CYCLONES FLO AND ED BASED ON TCM-90 OBSERVATIONS

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A case study of the upper-tropospheric forcing of the intensification rates of typhoons Flo and Ed has been accomplished. High-resolution, hand-drawn streamline analyses of the 150, 200, 250, and 300 mb winds from the final observational data set of the Tropical Cyclone Motion (TCM-90) field experiment were constructed for 00, 06, 12, and 18 UTC during the period 00 UTC 12 September through 00 UTC 19 September 1990. Three basic interaction mechanisms that appeared to have major roles in upper-level forcing on Flo and Ed were defined. Outflow layer changes were quantified through calculation of the mass divergence and eddy flux convergence of relative angular momentum using a radial-band averaging technique at 200 mb. A nearly 1:1 qualitative relationship was found to exist between the development of one or more of these mass/heat export mechanisms and corresponding changes in the intensification rates. These calculations from the best-ever typhoon region data set strongly suggest that upper-level forcing leads the intensification process by 12-24 h.

COMPARISON BETWEEN ARCTIC AND SUBTROPIC SHIP EXHAUST EFFECTS ON CLOUD PROPERTIES

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Radiative and physical characteristics of subtropic and Arctic shiptracks are compared through the use of AVHRR satellite data and an algorithm developed at the Naval Postgraduate School. Examination of channels 1 and 3 albedos within each region indicate the average subtropic shiptrack brightness is greater than that for Arctic tracks. Arctic shiptracks, however, tend to be brighter than their environment compared to subtropic shiptracks. Subtropic shiptracks tend to be wider and longer than Arctic shiptracks. Due to relatively small sample sizes, additional cases are required to prove statistical significance for channel 3 albedo, channel 3 albedo percent change, width, and length. Increased in-situ measurements are needed for the analysis of conditions necessary and detrimental to the formation of shiptracks.

WIND SPEED AND MOISTURE SENSITIVITY TESTS OF THE NRL LIMITED AREA DYNAMICAL WEATHER PREDICTION MODEL: AN OSSE STUDY OF ERICA IOP-4

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An Observing System Simulation Experiment (OSSE) is conducted to investigate the sensitivity of the Naval Research Laboratory (NRL) mesoscale model to atmospheric water and surface wind speed input. The explosively deepening ERICA IOP-4 storm which occurred off the North Carolina coast on 4 January 1989 is used as a case study. Wind speed and water vapor output from the full physics version of the model is shown to reasonably simulate data available from the Special Sensor Microwave/Imager. Assimilating this modeled satellite information into the degraded version of the model shows ERICA IOP-4 to be a dynamically driven storm. Assimilation of simulated wind speed observations yields the best performance for the degraded model in terms of surface pressure deepening. The model exhibits sensitivities to the coverage area of updated information. Two treatments for atmospheric water are tested, showing the sensitivity of the model to these inputs despite their secondary importance in forecasts of storm deepening.

INCORPORATION OF A RADIATION PARAMETERIZATION SCHEME INTO THE NAVAL RESEARCH LABORATORY LIMITED AREA DYNAMICAL WEATHER PREDICTION MODEL

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This paper describes the incorporation of the Harshvardhan et al. (1987) radiation parameterization into the Naval Research Laboratory Limited Area Dynamical Weather Prediction Model. A comparison between model runs with the radiation scheme and runs without the scheme was made to examine three mesoscale phenomena along the west coast of the United States during the period 0000 UTC 02 May 1990 - 1200 UTC 03 May 1990: the land and sea breeze, the southerly surge and the Catalina eddy. In general the updated model with the radiation parameterization yielded a more accurate simulation of the layer temperatures, geopotential heights, cloud cover, and radiative processes a verified from synoptic, mesoscale and satellite observations. Subsequently, the updated model also forecast a more realistic diurnal evolution of the sea and land breeze, the southerly surge and the Catalina eddy.

MODELING PULSE TRANSMISSION IN THE MONTEREY BAY USING PARABOLIC EQUATION METHODS

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Acoustic tomography signal transmissions in the Monterey Bay is modeled using the time-domain parabolic equation method of Collins and Westwood (1991). Comparison of the model output with the measured arrival structures obtained in Monterey Bay in 1988 shows that this Fourier synthesis can produce good agreement with data. Furthermore, identification of the measured modal arrivals is possible by decomposing the PE model output into individual normal modes. Modal identification provides for the application of tomography in shallow water.

APPLICATIONS OF PASSIVE MICROWAVE SATELLITE DATA FOR ARCTIC SEA ICE STUDIES

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Passive microwave satellite data provides all-weather, continuous observations of the polar ice cover. Multichannel radiometer data sets extending back to 1978 are readily available and distributed on CD-ROM media. Current algorithms can extract information on ice cover, concentration and type. Two applications of these data sets for polar studies are explored: 1) the possible detection of altered ice morphology due to anomalous tidal currents in the Yermak Plateau region; and 2) the tracking of multiyear ice features to infer ice motion. No evidence of altered ice morphology in the Yermak Plateau region was detected. Either the reported anomalous currents do not affect ice morphology or the limitations inherent to passive microwave imagery (poor spatial resolution) prevent detection. On the other hand, distinct multiyear ice features are observed to move in the direction of mean ice flow and are well correlated with the motion of nearby data buoys. Short-term ice motion vectors are unreliable because of the low spatial resolution of the passive microwave data. However, long-term averages are indicative of ice flow trajectories and can be used, for example, to increase our knowledge of the interannual variability of heat and salinity budgets in specific regions, including Fram Strait, the principal outflow region of the arctic basin.

MASTER OF ARTS/SCIENCE
IN
NATIONAL SECURITY AFFAIRS

THE NEW WORLD ORDER: ENDURING CURRENTS IN AMERICAN FOREIGN POLICY
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Advisor: David Winterford-Department of National Security Affairs

The primary focus of this thesis is an attempt to show that President Bush's New World Order reflects enduring currents in U.S. foreign policy. This assessment is undertaken through delineating, examining and evaluating three major "schools" of thought which have influenced American foreign policy. The three "schools" are isolationism, realism and idealism. The assessment of these schools of thought is based on an examination of critical writings of leading architects, practitioners and specialists of American foreign policy. The thesis seeks to suggest that these schools are constantly interacting in American politics, and constantly seeking to capture the dynamics of American foreign policy. Thus, the major objective of the thesis is to delineate these schools, indicating their impact on particular American policies and relating them to the evolution of American thought to date as expressed in the ideals of the New World Order.

MULTISPECTRAL IMAGERY: AN ESSENTIAL TOOL FOR TODAY'S NAVAL OPERATIONS
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This thesis examines the essential use of Multispectral Imagery (MSI) land remote sensing data in support of future military operations, specifically naval operations. The importance of proper management of the Landsat program and funding are discussed in depth. Results of surveys from naval intelligence specialists and operators express the interest of the Fleet in the need for MSI for future military operations. To continue its lead in remote sensing systems, the U.S. must consider foreign competition, such as that from the French Spot system. Examination of this competition, how the U.S. will cope with it, and planning implications from the spread of foreign MSI capabilities, are discussed. Recommendations for the future of the Landsat program and MSI are listed.

BLINDING THE EYES OF THE CORPS: FORESIGHT AT LAST?
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This thesis juxtaposes the enabling attributes of tactical aerial reconnaissance with the myopic force structure policy which resulted in the demise of Marine aerial reconnaissance on the eve of the Persian Gulf War. Commencing with the debut of American photo reconnaissance aircraft in World War I, and continuing through the present, the U.S. tactical aerial reconnaissance capability problematic development cycle of high emphasis during war and gross neglect during peacetime is documented. For the United States Marine Corps, the impact of this trend of dysfunctional command priorities during Desert Shield/Desert Storm contingency operations in Southwest Asia is elucidated and the misnomer of "intelligence failure" is revealed. Based on analysis of these events and the recurring intelligence requirements of combat, this thesis sets forth the requirement for continuous maintenance of a viable tactical aerial reconnaissance capability within the Marine Corps.

PRESS COVERAGE OF THE PERSIAN GULF WAR: HISTORICAL PERSPECTIVES AND QUESTIONS OF POLICY BEYOND THE SHADOW OF VIETNAM

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Widely held views of military-press relations in the United States rest upon an incomplete image of the past. This became overwhelmingly evident during the recent Gulf War with its generalizations about the experience of the Vietnam War. This thesis seeks to correct such failings through a brief discussion of the role the First Amendment guarantee of freedom of the press has played regarding U.S. national security interests, followed by a thorough description of military-press relations in the 19th and 20th centuries. Chief emphasis is upon American war since 1965, with an analysis of press policy both before and during the Gulf War. It is shown that policy decisions have evolved from historical precedent and "lessons learned" from previous wars. Moreover, preliminary review of the secondary literature suggests that there exists far more continuity in U.S. military press relations than is widely perceived in the body politic and among the press. The Vietnam case, most often portrayed as devoid of military press control, can be seen as an exception, rather than the rule. Further, the Sidle Commission as well as the experiences in Grenada in 1983 and Panama in 1989 reflect a backlash against the press policy of the Vietnam War. A close examination of USCENTCOM's public affairs guidance suggests that the makers of DoD and theater press policy fully understand the need to avoid the perceived mistakes of Vietnam as well as the requirement to argue the military's case in a forceful and persuasive manner. The public backlash against the electronic media in the Gulf War, coupled with the general affection felt in American hearts and minds for the professional military, suggests that present aggressive U.S. military policies toward the press will continue. The thesis concludes with an examination of those outstanding areas of policy that demand careful attention along with recommendations toward improving future military-press policy.

INTELLIGENCE DATABASE SUPPORT FOR NAVAL ARMS CONTROL

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and
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The database contained in this thesis was put together from unclassified sources. It is stored on computer disk using the Lotus 123 software program and is easily updated and manipulated. This database was created to provide support to U.S. Naval arms control negotiators in the event that the Navy is forced to the negotiating table. This thesis does not advocate naval arms control. However, given the current political climate it is prudent to be prepared for such an eventuality. This assessment utilizes a methodology for determining excess naval forces of the Soviet Union that would be targetable in arms control talks. In order to quantify the excess, we constructed a Soviet naval model that would be adequate to meet Soviet security goals under "defensive defense" doctrine. Our goal was not to present the Soviet Union with a plan of action but to come up with a reasonable estimate of what their force structure is likely to resemble. Again, it is the methodology which is important here, as specific numbers can easily be changed using the Lotus program to account for classified information or changing developments. Once we established the current force levels and a model of likely forces necessary under "defensive defense," it was easy to determine an excess of Soviet naval forces. Our findings are summarized in the following: Excess Forces: Strike Submarines 140, Surface Strike -9, Surface ASW -6, Surface Escorts 22, Mine Warfare 161, Amphibious 61, Long Range Air 35, Attack Subs 26, Theater Surface 575, Patrol Combatants 62, Theater Aircraft 218.

THE NAVY AND JOINTNESS: NO LONGER RELUCTANT PARTNERS?

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This thesis examines the intention and effectiveness of the changes initiated by the Goldwater-Nichols Department of Defense Reorganization Act of 1986 (GNA) with emphasis on the United States Navy. This assessment considers the implications for future national security of present trends in the balance of power between joint and service institutions within the Department of Defense (DoD). Interviews conducted by the author with key individuals involved in the writing and implementation of GNA legislation, coupled with a review of the literature, provide the basis for understanding the intent behind GNA and its provisions. In assessing the effectiveness of GNA, this thesis focuses on three areas: operations, plans, and people and how the key change mechanisms implemented by GNA are impacting these areas. The author forwards policy recommendations, for both DoD and the Navy aimed at making "jointness" more relevant and meaningful.

CRUISE MISSILE PROLIFERATION: AN APPLICATION OF BAYESIAN ANALYSIS TO INTELLIGENCE FORECASTING

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This thesis examines the manner in which the technique of Bayesian analysis may be applied to the forecasting of cruise missile proliferation. Bayesian analysis is a quantitative procedure in which alternative hypothetical outcomes are postulated and their prior probabilities estimated. As additional relevant events occur, the probabilities of their association with each hypothesis are used to calculate a revised probability for each alternative outcome. To support a sample analysis, this thesis traces the historical development of cruise missiles, discusses the various motivations for their acquisition of indigenous production by a developing nation, and identifies technologies crucial to the building of an advanced cruise missile system. After describing the Bayesian method and demonstrating its use in a theoretical example, the thesis concludes with some of the policy implications of cruise missile proliferation and its forecasting by the intelligence community.

TUNISIA: ISLAM AS A POLITICAL FORCE

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In the wake of the Iranian revolution, Middle Eastern countries are experiencing a resurgence of populist Islam. Described as "fundamentalist", these movements appear to be serious threats to the governments of these countries. In Tunisia, the government has virtually halted its promised democratic reforms claiming that the Islamists will use the political process to gain control of the government and that they are violent radicals attempting to overthrow the government. This thesis argues that the Islamic movement in Tunisia is neither revolutionary, radical, nor fundamentalist. Islam has played an important role historically in the creation of Tunisian nationalism and the current movement is a political movement attempting to reform a repressive, unresponsive regime.

DETERRING NUCLEAR-ARMED THIRD WORLD DICTATORS: A TARGETING STRATEGY FOR THE EMERGING THREAT

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The continuing efforts of several developing nations to acquire nuclear weapons indicates that the United States may be required to implement a deterrence policy aimed at authoritarian regimes in the Third World. Therefore, U.S. decision-makers must re-evaluate the conceptual foundations of American deterrence policy. This research suggests a solution to the problem of deterring nuclear-capable Third World nations from using nuclear weapons against the United States, its allies and friends. The new deterrence policy is based on the theory of omnibalancing which predicts that the Third World dictators are strongly influenced by perceived internal threats to their regime. Successful deterrence, therefore, is dependent on holding at risk the mechanisms used by Third World authoritarian regimes to maintain internal control. Although developing a nuclear deterrence policy against Third World dictators is critical to the security of the United States, there has been a hesitancy for Western analysts to consider the problem of Third World nuclear deterrence because they either perceive that these regimes are irrational and therefore non-deterrable or they believe that the U.S. nuclear arsenal in itself will provide deterrence. This analysis addresses the flaws of these perceptions and offers an analytical basis for new U.S. strategic thinking about deterrence and the Third World. A deterrence policy based on omnibalancing can be a viable means of preventing Third World nuclear use against the United States and its interests.

THE UNITED STATES AND ENVIRONMENTAL SECURITY: DEFORESTATION AND CONFLICT IN SOUTHEAST ASIA

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In the post Cold War era, the East-West conflict may be succeeded by a new confrontation which pits an industrialized North against a developing South. In June 1992, world attention was fixed on the Earth Summit in Rio de Janeiro. This event marked a milestone in global environmental awareness; but just as the end of the Cold War has provided new opportunities for the U.S., the world is now faced with new sources of conflict which have advanced to the forefront of the national security debate. Among the new sources of conflict, environmental problems are rapidly becoming preeminent. Within national security debates, those environmental problems which respect no international boundary are of particular concern. Worldwide deforestation, and the related issues of global warming and the loss of biodiversity, represent a clear threat to national security. Two percent of the Earth's rainforests are lost each year; one 'football field' is lost each second. Deforestation has already led to conflict and instability within several regions of the world including Southeast Asia. The United States must recognize the character and dynamics of these new sources of conflict in order to successfully realize its policy aims in national security. The U.S. should preempt conflict through cooperation and develop a shared concern for the environment throughout the world. The U.S. military may play a key role in this effort.

TWO STEPS FORWARD, ONE STEP BACK: THE PATTERN OF RUSSIAN LIBERAL REFORMS AND ITS IMPLICATIONS FOR RUSSIA AND THE UNITED STATES

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The current political and social turmoil in the erstwhile Soviet Union challenges the U.S. to devise new methods for effectively dealing with Russia and the independent republics of the Commonwealth. Part of this challenge involves the evaluation of the most likely changes arising from the revolution, the most probable course of events, and their implications for U.S. foreign relations. This thesis argues that past Russian liberal reforms have followed a definite pattern, and that an examination of this pattern can provide U.S. foreign policymakers a tool to understand the context and dynamics of today's situation. Ultimately, this thesis argues that the U.S. must become thoroughly intertwined with Yeltsin's Russia to support the formation of a liberal democratic society, or risk the backlash of conservative Russian elites.

BULLETS WITH NAMES: THE DEADLY DILEMMA

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The United States, by executive order, has unilaterally forfeited assassination as an instrument of foreign policy. Some Americans now believe that the declared prohibition unreasonably limits U.S. capability to counter the national security threats posed by terrorists, revolutionaries and Third World crusaders. This thesis is an examination of the policy dilemma which political assassination presents. There are circumstances in which utilitarian calculations would endorse assassination as the most moral application of deadly force. Yet the draconian practice of assassination as an instrument of American foreign policy seems to contradict democratic ideals. This thesis details both arguments and draws two major conclusions. First, assassination cannot support long-term U.S. policy goals or warfighting efforts. Ultimately, such methods could weaken America's global position. Second, while assassination has no place in America's warfighting arsenal, the ban itself has become dysfunctional and requires reevaluation.

LEGITIMACY AND HAFEZ AL-ASAD

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It has been taken for granted that Hafez al-Asad relies exclusively upon an iron fist to perpetuate the survival of his regime. Close scrutiny of Asad's presidency, however, betrays the inadequacy of this explanation. In fact, Syria's conflict with Israel is the primary legitimizing agent for Asad's minority-Alawi regime, and it is because of this conflict that Asad's regime has endured. Consequently, the absence of a militant confrontation with Israel poses risks which the present Syrian leadership has been unwilling to assume. Furthermore, this condition acts as a restraint upon certain types of foreign policy activities and initiatives which Asad might otherwise elect to pursue. The reality of Israel's legitimizing function has specific relevance to U.S. foreign policy vis-a-vis both Syria and Israel, particularly regarding the peace process.

UNITED STATES WARSHIP TRANSFERS TO ARGENTINA, BRAZIL, AND CHILE: OPTIONS FOR U.S. POLICY

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The United States Navy plans to decommission several classes of warships in the next decade. Each of the major Southern Cone countries of Latin America (Argentina, Brazil, and Chile) has a geopolitically-driven need for a blue-water navy. Each of these navies needs frigates and destroyers to achieve blue-water status. This thesis examines U.S. ship transfer policy to the Southern Cone. It concludes that the Adams-,Coontz-, and Knox-class ships, that the U.S. Navy is beginning to decommission, should be leased to the Southern Cone navies in order to bolster their naval forces and to support mutual maritime security interests. The poor economic status of these countries mandates that lease terms be made as favorable as possible and that the annual number of ship leases be kept to a few.

SOVIET ANTILANDING DOCTRINE: DOES IT MATTER?

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The new national security strategy will have both short and long-range effects on all branches of the military. This requires a close examination of the implications that such dramatic changes could have on the military and their ability to respond to the broad spectrum of crises that could occur in today's dynamic political situation. Although the threat from the Soviet Union has diminished and while no one seriously believes that the U.S. and the Soviet Union will engage in conflict, especially on Soviet soil, the need still exists to examine Soviet doctrine and warfighting capabilities in relation to U.S. capabilities and strategies. We need to study Soviet antilanding doctrine because of the possibility of U.S. forces encountering Soviet-trained enemies or the remote possibility of contingency operations against the U.S.S.R. in regional/local wars. Finally, it is necessary for U.S. strategic planners to continuously track Soviet antilanding concepts in the unlikely event of a reconstitution scenario resulting in a big war with the U.S.S.R. or whatever replaces it.

THE RETURN OF THE "GOOD NEIGHBOR": A POLICY FOR ACHIEVING U.S. OBJECTIVES IN LATIN AMERICA THROUGH THE NINETIES AND BEYOND?

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This thesis applies the "Good Neighbor" policy principles developed by President Franklin D. Roosevelt to U.S. interests in Latin America today. Good Neighbor policy principles are identified and specific goals of the policy are analyzed. These are compared to current U.S. security interests which are themselves analyzed in terms of their relevance to U.S. policy toward Latin America in the 1990s. The international climate and issues of the early 20th century are compared to today's issues and environment. It is determined that broad similarities do exist in terms of U.S. policy objectives. Specific differences are also identified and the Good Neighbor policy principles are re-interpreted to account for these differences. Five options for U.S. policy toward Latin America are discussed. The thesis concludes that a policy of cooperative multi-lateralism, based on revised Good Neighbor principles, is the most effective policy for achieving U.S. objectives in Latin America.

THE BRAZILIAN MILITARY: ITS ROLE IN COUNTER-DRUG ACTIVITIES

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This thesis examines the role of Brazil's military in counter-drug operations. Drug trafficking in Brazil poses a growing threat to the country's national security, but Brazil's physical size and limited resources have hindered the government's counter-drug efforts. The Brazilian military has been reluctant to assume a more significant role in counter-drug operations. The thesis argues that external, internal, and institutional pressures are driving the Brazilian military to expand its counter-drug role. The thesis recommends that the Brazilian military expand its current support role in counter-drug operations, but that it avoid a direct role in law enforcement operations. The United States should support this expanded role, but only to the extent that such a role does not threaten the further consolidation of democracy in Brazil.

INTELLIGENCE: A PERSONAL, INHERENT, FUNCTION OF COMMAND

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This thesis suggests that commanders must accept the responsibility for intelligence as a personal, inherent, function of command. Commanders most dissatisfied with intelligence least understand its function, capabilities, and limitations. They lack a thorough understanding of intelligence, thus they fail to directly participate in the process, and their involvement is critical to success. Intelligence doctrine - the foundation of instruction in professional schools - fails to increase understanding and forcefully encourage the commander's participation. This thesis further suggests that doctrine reinforces past and present tendencies relating to intelligence, causing many commanders to fail to see intelligence as a personal, inherent, function of command.

RUSSIAN-JAPANESE ACCOMMODATION: A THREAT TO AMERICA'S STRATEGIC POSITION IN THE PACIFIC?

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The end of the Cold War presents the United States with new opportunities and challenges. During the Cold War, the U.S.-Japanese relationship was the linchpin of security in the Pacific. With the collapse of the Soviet Union, it seems logical to analyze pre-Bolshevik foreign policy to ascertain the likely direction of Russian policy in the Pacific. Russia and Japan have had economic relations throughout their history; one of the primary obstacles to normalized relations has been the Kurile Islands. Since Yeltsin has indicated his willingness to negotiate on the issue of the islands, the possibility exists for closer Russo-Japanese relations. The reliance on military power has been overtaken by the need to ensure a country's economic health. Japan, an ally during the Cold War, can now be viewed as an economic competitor. Russia, an adversary during the Cold War, could be become an economic ally. Continued U.S. influence in the Pacific requires a re-assessment of traditional relationships. Alliances unheard of during the Cold War are now possible. Closer ties between Russia and Japan could present new challenges to the United States in the Pacific. In order to prevent a loss of influence in the Pacific, new policy choices with regard to Russia and Japan need to be examined.

VIETNAM IN U.S. FOREIGN POLICY: AN ASSOCIATION FOR THE STRATEGIC BALANCE IN SOUTHEAST ASIA

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Advisor: Claude A. Buss-Department of National Security Affairs

This thesis asserts that it is critical for the U.S. to re-evaluate its foreign policy toward Vietnam and to begin viewing that country's strategic potential for meeting future threats to Southeast Asia: specifically the Chinese military threat, a threat based on China's territorial claims in the South China Sea and an aggressive program of modernization of China's military; and the Japanese economic threat, a threat reinforced by Japan's use of conditional aid, financial control of major industries throughout the region, and a structural dependency on imports of critical raw materials, primarily from Southeast Asia. America's relations with Vietnam have remained virtually unchanged since U.S. forces were withdrawn in April, 1975. However, the end of the Cold War and the collapse of the Soviet Union have released the U.S. from its need to view Vietnam as an extension of Moscow's influence in Southeast Asia. A policy of constructive engagement with Vietnam permits the U.S. to maintain the balance of power in Southeast Asia against encroaching Chinese and Japanese threats. America's economic interests in Asia, now one-third larger than in Europe, also create an imperative for change and the potential of Vietnam, in resources, manpower, and strategic location, should be made a factor in future policy formation.

WHY THE UNITED STATES SHOULD NEGOTIATE A BAN ON NAVAL TACTICAL NUCLEAR WEAPONS

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The naval tactical nuclear weapons that the U.S. Navy has in storage neither provide adequate deterrence nor increased warfighting capability. If the U.S. and the U.S.S.R. eliminated these weapons the U.S. Navy would be in a more dominant position compared to the Soviets. With both the U.S. and U.S.S.R. announcing unilateral removal of their tactical nuclear weapons from naval units, while at the same time maintaining them in storage, the U.S. has tacitly agreed to a ban on these weapons without making any provisions for verifying Soviet compliance. This is not a good situation, all the drawbacks associated with these weapons remain, and none of the benefits of removing them from the inventory have been realized. As long as tactical naval nuclear weapons exist, the costs for maintaining, storing and training on these weapons will continue to be incurred. Moreover, in the present situation of unverified agreement, the Soviets still have access to non-strategic naval nuclear weapons. There is no assurance that some of these weapons will not find their way onboard a Soviet warship during unsettled times in the U.S.S.R. These issues can be resolved if the U.S. seeks a mutually verifiable treaty with the U.S.S.R. completely banning naval tactical nuclear weapons.

GERMAN SECURITY POLICY: CONTINUITY AND CHANGE

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This study examines the continuities and changes in the security policies of the newly reunified Germany, providing background for American policy makers and strategists concerned with questions about Germany's future. Germany's actions in the year and a half since unification have been less than reassuring for American statesmen. In the Gulf War, Germany refused to participate militarily in the American led coalition on constitutional grounds. Then in December of 1991, Germany refused to go along with the policies of the United States and its major European allies in linking recognition of Yugoslavian republics to an overall settlement of the civil war in that country. In pursuing these initiatives, Germany demonstrated that it no longer occupied the position of junior partner to the United States in the foreign policy field and that it had national security policies of its own to pursue which were sometimes more European than Atlantic oriented. This attitude unjustifiably alarmed many American and European statesmen who had grown comfortable with the passive policies of the West German government and the constraints that the cold war had built into the European security system. The year 1989 marked the end of the cold war and forces Germany to contend with global responsibilities and influence that it has not had to contend with since 1945 using the political culture that it has evolved in that time. This study covers the historical development of the present statecraft, the sources of change in Germany, and a case study of the Yugoslavian conflict.

THE GUADALAJARA ACCORD BETWEEN BRAZIL AND ARGENTINA: A TENTATIVE STEP TOWARD THE NUCLEAR WEAPONS-FREE LATIN AMERICA ENVISIONED BY THE TREATY OF TLATELOLCO

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In 1967, the Treaty of Tlatelolco declared Latin America to be a nuclear weapons-free zone, but this goal remains unfulfilled. Argentina and Brazil, the Latin American nations most capable of building nuclear weapons, refuse to comply with the treaty. Argentine and Brazilian military leaders pursued the development of nuclear weapons from the 1970s to the late 1980s. The emergence of democratic regimes during the 1980s encouraged the gradual "denuclearization" of weapons research in these nations. In July 1991, the presidents of Argentina and Brazil signed an accord in Guadalajara, Mexico, each promising to abandon the development of nuclear weapons. The risks of nuclear proliferation may be reduced because of this agreement. The Guadalajara Accord offers hope that nuclear proliferation in Latin America can be slowed and perhaps stopped. The establishment of civilian control over the military and the reduction in the belligerent rivalry between Argentina and Brazil are central factors in ending the quest for nuclear weapons. The firm commitment of these civilian leaders to pursue only peaceful nuclear activities is a positive sign. The adoption of IAEA full-scope safeguards in Argentina and Brazil will be the best guarantee for a nuclear weapons-free Latin America.

BACK TO THE FUTURE: THE ROLE OF THE FOUNDING FATHERS IN SHAPING THE NEW WORLD ORDER

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At the close of the Cold War the United States faces the difficult task of defining what it stands for, what its long-term goals are and the means it is willing to use to attain these goals. This thesis investigates the role American core values played in the two historical operational codes of the United States - nation building of the Founding Fathers, and the Cold War containment policy. It examines the relationship of paradigm change on values, perceptions and policy. It attempts to develop case studies which exemplify that relationship. Additionally, a long-range planning model is presented for use in framing the debate on options presented for a new operational code. Finally, it goes on to suggest what part American values should play in the operational code the nation develops to shape the "New World Order."

BEYOND THE WARSAW PACT: RUSSIAN FOREIGN POLICY IN EAST CENTRAL EUROPE IN THE 1990s

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The breakup of the Soviet Union and the head long rush of its former East European satellites to rejoin the West have placed Russia in a difficult position. Faced with seemingly insurmountable political and economic difficulties as it makes its transition from communism and a centrally planned economy to its own form of democracy and a market economy, Russia realizes that it needs Western aid and technology. On the other hand, similar attempts by its former East European satellites threaten to isolate Russia from the rest of Europe. In the immediate post-Cold War era, it is the task of Russian foreign policy to prevent Russia's isolation from Europe. A Russia denied the benefits of European trade and political and economic assistance can only sink into domestic chaos. This thesis examines Russian foreign policy in the immediate post-Cold War era in relation to Czechoslovakia, Hungary, and Poland, the three East European nations which promise to hold the keys to Russian participation in or isolation from the European system. The thesis examines the Russian national interest in the region, as well as the evolving security and economic relationship between Russia and East Central Europe. The thesis concludes that the task of Russian foreign policy in the immediate post-Cold War era is to develop better economic relations with Czechoslovakia, Hungary, and Poland.

THE NEW EUROPEAN ORDER: HISTORICAL PERSPECTIVES AND PROSPECTS FOR AN ITALIAN ROLE
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This thesis begins by examining the history of Italian participation in Europe's southern flank since 1945, focusing upon the reasons for their apparent weakness in taking a leading role. It then considers Italy's present posture within the new European order and attempts to make informed judgements as to the course of its role in European security. Europe has had two restructurings in recent history. This thesis examines the development of Italian statecraft after the first changes in 1945 to see if anything may be gleaned and applied to Italy's posture after the changes in 1991.

WEST EUROPEAN DEFENSE IDENTITY: IMPLICATIONS FOR U.S. SECURITY POLICY
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This thesis examines whether the development of a West European defense identity could result in the marginalization of the United States in European security affairs. The fundamental changes in the European security environment since 1989 provide the starting point for the analysis. The thesis reviews U.S. and West European assessments of the risks and threats affecting European security, and several of the other key issues associated with the quest for West European defense identity: motives for such an identity, prospects for West European nuclear cooperation, Germany's role, and NATO's future in the changing security environment. The thesis concludes that, while many factors in European-American relations and international politics will shape the future of the Atlantic Alliance, the U.S. Government, and the Congress in particular, will play perhaps the pivotal role in determining the extent of future U.S. participation in European security affairs.

THE POLITICS OF NUCLEAR WEAPONS
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This thesis evaluates the role of the House and Senate Armed Services Committees, the House and Senate Appropriations Committees, and the Democratic Caucus in matters pertaining to strategic nuclear weapons programs. Three strategic programs are used as case studies to support this evaluation; the Trident submarine and missile, the B-1 bomber, and the MX missile. By comparing each committees' funding recommendations to that approved by Congress as well as their success in blocking amendments which would affect such recommendations, it is apparent that the respective Armed Services Committees dominate in strategic nuclear issues. This was found to be true when strategic nuclear programs were debated largely within the confines of the committees as well as when they reached the Congressional agenda. The MX missile, however, was a significant exception as it resulted in a shift of power away from the House Armed Services Committee and to the liberal arms control activists, via the forum of the Democratic Caucus. A detailed analysis of the MX case provides much useful information for strategic planners concerning the formulation of new strategic nuclear weapons programs, demonstrating the potential pitfalls and proposing ways to avoid these pitfalls; and if they can not be avoided, what could be the possible consequences.

COALITION WAR AND BURDEN-SHARING: THE PRESIDENT VS THE CONGRESS

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This thesis examines past U.S. approaches to coalitions and efforts to forge alliances in peace and war in the 20th century. Specifically, it analyses the conflict between the executive and legislative branches with respect to coalition building and burden-sharing. The thesis suggests that the amount of Congressional activism depends upon the perception of an external threat among members of the legislative branch. Likewise, the thesis highlights the tension between Congressional desires to impose the burden upon allies while retaining exclusive control over coalition policy and forces. The thesis concludes with a case study of Operation Desert Storm and burden-sharing. Finally, the author warns of dangerous precedent established by the shift in burden-sharing responsibilities in the recent past between the executive and legislative bodies.

THE UNITED STATES IN UNITED NATIONS MILITARY OPERATIONS

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This thesis examines the role of the United States in United Nations military operations. In a future that will likely include more instances of U.N. security operations and a U.S. military having to make do with less resources, collective security operations are a logical choice for U.S. decision-makers. The study begins with a discussion of six types of U.N. military operations, ranging in intensity from humanitarian aid to enforcement and punishment. The study also provides a decision model that accounts for the effects of elite and popular consensus domestically and internationally on the collective security process; Iraq and Bosnia act as illustrative examples. The study than examines the roles played by the U.S. Navy and intelligence community in collective security. In summary, the study concludes that the U.S. military is best suited for operations at either extreme of the collective spectrum. In other instances, limited action by the U.S. Navy or intelligence community are viable alternatives.

BURMA ON THE BRINK: COMPLICATIONS FOR U.S. POLICY IN BURMA

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This thesis discusses the issues and circumstances present in Burma which have complicated and frustrated U.S. counter-narcotics efforts and overall U.S. policy in the past. The thesis attempts to forecast the future of Burma and suggests needed reforms for development. Potential U.S. policy is proposed which accounts for the political instability and economic decline of Burma while remaining within internationally recognized guidelines.

THE FUTURE STATUS OF PUERTO RICO: IMPLICATIONS FOR U.S. FOREIGN POLICY

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This thesis discusses the evolution of U.S.-Puerto Rican relations and the current drive to permanently define the island's political status. It analyzes the pros and cons of the three status options (statehood, independence, and enhanced commonwealth) in terms of U.S. national interest. It argues that the status selected will have significant implications for the U.S. interests, especially in the military (Caribbean security and the war on drugs) and economic spheres. The thesis examines the historical and present day influence of the U.S. Congress on Puerto Rico's political status. In so doing it indicates what dominant national interest will most likely affect the outcome of a status plebiscite. It concludes that the most desirable status option for the United States and the Caribbean is the enhanced commonwealth status. However, Congress should approve a binding plebiscite only when Puerto Ricans have expressed a clear consensus for any particular option (no less than 60 percent). Until then, the status quo remains a flexible, viable position.

CHINESE-MIDDLE EAST RELATIONS AND THEIR IMPLICATIONS FOR U.S. POLICY

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China and the Middle East have engaged in various interactions throughout the post-war period. This thesis looks at those interactions and postulates a purposeful intent underlying Chinese-Middle Eastern activity. Purposeful intent is deduced from a consideration of extant and subsequently probable Chinese and Middle Eastern foreign policies. Vehicles for examining these foreign policies include: aspects of applicable domestic fabrics; those fabrics' perceptions of international requirements; external realities of the countries involved; the regional interaction itself. Economic, cultural, security and diplomatic issues are included. Likely goals and objectives of China and the Middle East through continued interaction are discussed. Israel and the other Levantine states comprise the two primary foci used to identify the Middle East region. China is discussed first from the period beginning with 1949 through to the ascendancy of Deng Xiaoping, then from the Four Modernizations and reform through to the present. Implications for U.S. policy regarding both China and the Middle East conclude the study.

WAR AS ART OR SCIENCE: A HUMANIST VISION

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This thesis attempts to answer the question, "Is War art or science?" In doing so it draws heavily upon Thomas Kuhn's "humanistic" philosophy of science. If "War" can be separated theoretically into two distinct analytical units, preparation for war, and conduct of war, then the answer to the question becomes more accessible. The war preparation process is notably similar to the Kuhnian dynamic of scientific process, i.e., the evolution of a paradigm through inter-disciplinary criticism and rearticulation. A case study of post-WWII U.S. nuclear strategy is offered to substantiate the claim that war preparation operates in a way that is remarkably similar to Kuhnian science. So, if war preparation is scientific, then the conduct of war, a fundamentally different activity, may be seen as artistic. This case is made by drawing heavily upon the writings of General Carl von Clausewitz, and the 18th century German idealist Immanuel Kant. The end result of the work is to posit the existence of two types of men necessary for the execution of War, those who demonstrate ability in the sublime genius of science, and those who are more suited to develop the heroic genius of battle. The thesis suggests a reevaluation of U.S. military education as to its ability to identify and enhance the opportunities of these distinctive men within the armed forces.

THE CHINA-AFRICA CONNECTION: IMPLICATIONS FOR UNITED STATES FOREIGN POLICY

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Over the past 40 years the central theme and organizing principle of global political, military and economic existence has been the East-West conflict. Now with the ending of the Cold War and international economic restructuring, the primary global struggle may very well be transformed into a North-South Conflict. This thesis examines the role of the Peoples Republic of China in Third World affairs and the use of its self-proclaimed "Third World Leader" posture as a mechanism for achieving its own goal of becoming a full-fledged global power by the 21st century. In particular the thesis focuses on China-Africa relations. China views the prospect of a "New World Order" as a threat to the interests of the Third World. Consequently China has embarked upon a diplomatic offensive designed to strengthen political, economic and strategic relations with Africa as well as other Third World nations. With nation states and politico-economic alliances changing faster than many could imagine the PRC-Third World relations especially PRC-African relations deserve focus and attention.

INTELLIGENCE DATABASE SUPPORT FOR NAVAL ARMS CONTROL

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The database contained in this thesis was put together from unclassified sources. It is stored on computer disk using the Lotus 123 software program and is easily updated and manipulated. This database was created to provide support to U.S. Naval arms control negotiators in the event that the Navy is forced to the negotiating table. This thesis does not advocate naval arms control. However, given the current political climate it is prudent to be prepared for such an eventuality. This assessment utilizes a methodology for determining excess naval forces of the Soviet Union that would be targetable in arms control talks. In order to quantify the excess, we constructed a Soviet naval model that would be adequate to meet Soviet security goals under "defensive defense" doctrine. Our goal was not to present the Soviet Union with a plan of action but to come up with a reasonable estimate of what their force structure is likely to resemble. Again, it is the methodology which is important here, as specific numbers can easily be changed using the Lotus program to account for classified information or changing developments. Once we established the current force levels and a model of likely forces necessary under "defensive defense," it was easy to determine an excess of Soviet naval forces. Our findings are summarized in the following: Excess Forces: Strike Submarines 140, Surface Strike -9, Surface ASW -6, Surface Escorts 22, Mine Warfare 161, Amphibious 61, Long Range Air 35, Attack Subs 26, Theater Surface 575, Patrol Combatants 62, Theater Aircraft 218.

ASSESSING THE IMPACT OF "REASONABLE SUFFICIENCY" ON THE STRUCTURE AND MISSIONS OF THE FORMER SOVIET NAVY

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Using content analysis of original writings and speeches by former Soviet military and political leaders, this paper ascertains the impact of the concept of **reasonable sufficiency for defense** on the former Soviet military in general, and its Navy in particular. The research begins with the era of reform initiated in 1985 and ends coincidental to the dissolution of the former U.S.S.R. in December 1991. This review demonstrates that **reasonable sufficiency**, as a component of the new **defensive-defense** oriented Soviet military doctrine, significantly affected the organizational structure and assigned roles of the former Soviet maritime forces. The final chapter summarizes the historical aspects of **reasonable sufficiency** and projects the concept's future impact on the Russian Navy as the logical successor to the Soviet Navy. As the Russian Navy evolves from the roots of its predecessor, it will continue to play a viable role in the national defense of Russia. The influences of **reasonable sufficiency** on the Russian Navy will continue to be significant into the next century.

FROM ALLIANCE TO ACQUAINTANCE:
THE AUSTRALIAN-AMERICAN SECURITY RELATIONSHIP
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This thesis explores the development of Australian concepts of national security, in the context of traditional and continuing psychological dependency upon its links of alliance to the West. The Government claims that Australia's policy of defence self-reliance within an alliance framework is a 'conceptual watershed' that has 'liberated' Australian foreign policy; but it is an old theme in defence policy. Australia still awaits a real revolution in its security concepts and sense of regional and world identity. ANZUS, symbol of Australia's ties to the western community, and the false impressions and expectations it creates, now acts more to inhibit than to assist Australia's future growth as a nation.

THE GUNS-FOR DRUGS TRADE:
IMPLICATIONS FOR U.S. FOREIGN POLICY
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This thesis is a comprehensive study of the relationship between weapons and narcotics trafficking - a phenomenon referred to as the "guns-for-drugs trade." It focuses on trafficking that occurs throughout the United States and Latin America. The thesis identifies the actors, motivating factors, types of weapons, methods of smuggling, systems-dynamics, implications and prevalent problems found in combatting the trade. Several options are offered for U.S. strategy which include neglecting the problem altogether, increasing interdiction efforts, passing stricter laws and harsher penalties, increasing intergovernmental cooperation and bolstering cooperation among law enforcement agencies, both foreign and domestic. The thesis concludes that viable solutions must address both U.S. domestic and Latin American concerns and apply lessons learned during the drug wars.

NON-NUCLEAR DETERRENCE IN U.S. STRATEGIC POLICY:
INCENTIVES AND LIMITATION
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The thesis argues that significant incentives and sufficient means exist for the United States to further develop advanced conventional weapons to accomplish missions previously reserved for nuclear weapons on both the tactical and strategic levels of warfare. This conclusion is based on a survey of (a) apparent incentives for an increased reliance on advanced extended-range conventional weapons, (b) potential and limitations of such weapons, and (c) possible strategic implications of a greater emphasis on such weapons. Incentives examined include (a) the delegitimization of nuclear deterrence, (b) environmental, technical, and safety concerns associated with nuclear weapons, (c) the declining credibility of threats to use nuclear weapons in military operations in the more probable strategic contingencies in the foreseeable future, and (d) the more credible threat of discriminate advanced conventional weapons. Currently available weapons technology can be developed to strike a broad range of targets previously thought vulnerable only to nuclear weapons at costs competitive with nuclear weapons.

THE SOVIET COUP OF AUGUST 1991: WHY IT HAPPENED, AND WHY IT WAS DOOMED TO FAIL

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This thesis explores the events in the Soviet Union that preceded the August 1991 coup. In addition, it will examine the failure of the coup itself. Using a methodology of policy analysis, two questions are investigated. The first is why did Soviet President Mikhail Gorbachev seemingly align himself with conservatives during the Fall and Winter of 1990-1991? Secondly, once the conservatives were in a position to control the U.S.S.R., why did they fail? The first question is answered by showing that Gorbachev's movement away from reform was a pragmatic effort to retain his power as President of the U.S.S.R. The second question is answered by presenting evidence that reforms within the U.S.S.R. had progressed to such a point that the media and the people were able to perform an important role in defeating the coup. The fact that the majority of the Armed Forces failed to support the plotters was also very significant.

REVOLUTION AND REACTION IN EUROPE AND THEIR EFFECTS ON THE INTERNATIONAL SYSTEM

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This thesis examines two periods of major revolutionary change in Europe - France in 1789 and Central Europe in 1848 - to determine what forces emerged from the associated events to undermine the stability of the existing international system. Although both revolutionary periods were different, each produced the following destabilizing forces: heightened nationalism; a decline in the internationalist perspective among the ruling elites; instability among the ruling elites; conflict in the center of Europe; heightened awareness and importance of ideological differences; a breakdown in the cohesiveness of the international system; and finally diplomacy that was characterized by the pursuit of policies that had vastly greater ends pursued with greatly expanded means. Similar forces appear to be emerging in the aftermath of the upheavals of 1989, and therefore the friction in the international system will increase similarly to the past. In effect, the tentative uniformities among destabilizing forces after 1789 and 1848 will come into operation after 1989.

BACK TO THE FUTURE: THE ROLE OF THE FOUNDING FATHERS IN SHAPING THE NEW WORLD ORDER

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At the close of the Cold War the United States faces the difficult task of defining what it stands for, what its long-term goals are and the means it is willing to use to attain these goals. This thesis investigates the role American core values played in the two historical operational codes of the United States - nation building of the Founding Fathers, and the Cold War containment policy. It examines the relationship of paradigm change on values, perceptions and policy. It attempts to develop case studies which exemplify that relationship. Additionally, a long-range planning model is presented for use in framing the debate on options presented for a new operational code. Finally, it goes on to suggest what part American values should play in the operational code the nation develops to shape the "New World Order."

THE INDO-PAKISTANI NUCLEAR ISSUE: A U.S. POLICY PERSPECTIVE

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This thesis examines U.S. nonproliferation policy and the problem of nuclear proliferation in India and Pakistan. Its central hypothesis is that the end of the Cold War has created an opportunity to advance U.S. nonproliferation interests and work with both India and Pakistan to reduce the threat of a nuclear confrontation on the Indian Subcontinent. The thesis assesses both the motives for and the current status of the nuclear weapons programs in India and Pakistan. It also presents some plausible scenarios concerning future courses those programs could take. Finally, it presents a set of policy recommendations directed toward reducing Indo-Pakistani nuclear tensions and laying the foundation to make a future South Asian nuclear non-proliferation regime possible. Ultimately, this approach would create safer, more stable security arrangements for India and Pakistan and further reduce the threat from nuclear weapons in the post-Cold War world.

VERIFYING THE CHEMICAL WEAPONS CONVENTION: THE CASE FOR A UNITED NATIONS VERIFICATION AGENCY

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To successfully conclude a Chemical Weapons Convention, it is essential to establish a permanent United Nations verification agency. While the United States currently opposes a United Nations role in multilateral arms control verification, successes by the International Atomic Energy Agency in controlling nuclear weapons and the U.N. Special Commission in the disarmament of Iraq demonstrate a need for the United States to revise its position on this vital matter. Potential benefits of a permanent verification agency presented in this thesis center on the need for sharing heavy CWC verification costs, the unique challenges in monitoring multinational treaties, and the advantages of an in-place body to address difficult verification concerns prior to treaty implementation. Verifying a Chemical Weapons Convention will require tremendous financial resources and enhance the need for organizational efficiency and economy. A permanent U.N. verification agency could provide the forum for coordinating verification resources and advancing new proposals in arms control verification.

BUFFER OR HIGHWAY: CYCLICAL PATTERNS OF SECURITY DEVELOPMENT IN EAST CENTRAL EUROPE

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Since 1919, security foundations and specific architecture in East Central Europe have followed a repetitive cycle of policy behavior on behalf of the external power placed by circumstances into a position of preponderant influence within the region. This cycle of policy behavior contains elements of initial success, as well as of eventual failure. Exposing the two contradictory elements of this repetitive cycle, by disclosing a consistent pattern contained in selected variables, and then understanding the relationship between the current security environment in East Central Europe and traditional security conditions is the task of this analysis. This relationship suggests that the United States and its Western European allies should exercise caution and restraint with regard to formal integration of East Central Europe within the common security institutions of the West. The process of integration should be limited to informal or symbolic measures which encourage economic and political development, but which retain East Central Europe as a buffer between Western Europe and the Commonwealth of Independent States.

JAPAN: ASIAN PEACEKEEPER OF THE 21ST CENTURY?

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The building of a "New World Order" presents the United States with novel opportunities and problems. If the 21st century is to be the "Pacific Century", U.S.-Japan relations will become the cornerstone of U.S. Policy. The ongoing drawdown of U.S. forces places a renewed emphasis on the security relationship between the two countries. The United States has long desired an increase in the security role played by Japanese military forces. In the wake of the Cold War and the Gulf Crisis, Japanese opinion leaders are beginning to debate Japan's international security role. Within the context of the debate, an increasingly visible group of opinion leaders, the Internationalists, has emerged as the leading proponent of a greater Japanese security role. Their concept goes beyond Peacekeeping Operations under United Nations auspices. This thesis analyzes the security policy debate now occurring in Japan, with a special emphasis placed on the Internationalists. This assessment provides American policy leaders with important insights into the internal Japanese debate regarding Japan's probable new role in the Pacific. An understanding of Japanese domestic policy debates is vital in order for the United States to realize successfully her policy aims in the Asia-Pacific region. This study, sourced entirely from Japanese opinion leaders within the debate, serves to provide that insight.

CIVIL-MILITARY RELATION IN THE SOVIET UNION: POISED FOR CONFLICT

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The purpose of this research is to examine civil-military relations in the Soviet Union up until the events that led to the August 1991 coup d'etat. Using a historical backdrop and existing case studies, it was illustrated that the military and political leadership's had both conflict and consensus in their relationship. In an attempt to revive the stagnating Soviet economy, Gorbachev launched a radical reform of the military under the guise of glasnost, perestroika, and "new thinking". These changes had a significant impact on the civil-military relationship. Considerable access to the defense decision-making process was provided for a number of civilian institutions reducing the military's autonomy in military affairs. Gasnost provided the impetus for scrutiny and criticism of previous military policies demoralizing military leadership. Splits in the officer corps resulted from the enhanced political participation supported by Gorbachev. Lower and middle ranking officer in favor of radical reforms became disillusioned with the conservatism of the High Command. The degree of conflict rose between the military and Gorbachev as concessions on a host of arms control agreements, the collapse of Communist power in Eastern Europe, and the deteriorating situation between the central government and the republics left the military in a state of flux. Gorbachev's persistence toward further reform lead to the demise of the Communist Party and the ideology to which the military had been bound to serve. With no economic return in sight and an impending Union Treaty that would divulge a great deal of military decision-making to the republics, the disgruntled High Command pledged its support to the coup.

MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

A PROBABILISTIC APPROACH TO ASW DEPLOYMENT IN SHALLOW WATERS

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The Advanced Air Deployable Array (AdDA), which is a modern air-dropped fiber optic ASW device, provides an opportunity for the rapid enclosure of a hostile submarine in shallow waters. This thesis explores the effect of the deployment depth, and the effect of using longer or shorter AdDA array segments, on the performance of eight proposed AdDA deployment tactics which employ single or dual aircraft. It is shown that when the AdDA sinking rate is considered, several of the proposed tactics become infeasible for certain depth and submarine speed combinations. Still, today fiber optics offer unique capabilities for solving some of the U.S. Navy's and the Turkish Navy's problems in the future.

EFFECTIVENESS AND COST-EFFECTIVENESS EVALUATION OF AN ADVANCED ARTILLERY WEAPONS SYSTEM

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This thesis examines the role of modern artillery as a defensive as well as offensive weapon - one which is capable of destroying targets and achieving an advantage on the battlefield rather than merely performing traditional tasks of attrition. The thesis demonstrates that the new capabilities can be attained. A new concept of artillery weapon system - the Trajectory Corrected Artillery Rocket system (TCAR) - is analyzed. Results show that this new artillery system, when it contains a cluster bomblet warhead, is very effective against infantry in an open area, with destruction levels of 50 to 90 percent, but it is not sufficiently effective against fortified and armored targets. However, when this system accommodates SFM ("smart") submunitions, it proves effective against armored vehicles, with destruction levels of up to 70 percent. Simulation programs were developed which assessed damage levels on a variety of targets. A set of these targets was chosen for which a comparison analysis was made between the TCAR and two other well-known artillery systems: 155 mm gun and a free-flight artillery rocket system. Two parameters were tested: rate of kill and marginal cost. Results demonstrate the clear advantages of using TCAR over the other systems when accompanied by a cluster warhead. Furthermore, it was found that the TCAR is the currently preferred system suitable for SFM.

SCHEDULING THE PEACETIME ROTATION OF PAKISTAN ARMY UNITS

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Since Pakistan has greatly varying climates and terrains, the Pakistan Army rotates its units between locations so that no unit endures inequitable hardship or enjoys unfair advantage. Army peacetime policy specifies strict constraints on unit rotations, including restrictions on: the length of a unit's stay in any location, the number of units moving at any time, and the allowable replacements for any moving unit. Scheduling rotations manually in accordance with these rules, as is currently practiced, is extremely difficult and time-consuming. This thesis presents an integer programming model that finds feasible, minimum-cost schedules for planning horizons of up to eight years. The model also ensures that the units are positioned at the end of the planning horizon so that feasible schedules exist for future planners. The model is implemented with commercially available software: the GAMS algebraic modelling language and the XA and OSL optimizers. Schedules are obtained for realistic test problems in less than an hour on a 486/33 personal computer.

AN INDICATOR OF MESSAGE QUALITY FOR A SINGLE OPTICAL SENSOR USING A TEMPLATE-BASED TRACKING ALGORITHM

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The volume of messages generated by spaced based interceptors (SBI's) resulting from a booster launch can lead to an unacceptably large total time for the messages to propagate through the system. In order to help relieve this problem, one might identify the SBI's with the highest quality estimates of the launch information. Message traffic can be sharply reduced if these SBI's can be identified, and message transmission restricted to their messages. Launch parameters and position are estimated using a template based tracking algorithm. A single measure of quality based on the estimated covariance matrix of the measured position is proposed and tested using simulation. Results describe possible modifications to the template based tracking algorithm that would reduce error and allow the quality of a message to be determined.

ANTI-UAV DEFENSE FOR GROUND FORCES AND HYPERVELOCITY ROCKET LETHALITY MODELS

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This thesis analyzes the threat that unmanned aerial vehicles (UAVs) pose to U.S. ground forces. The operational environment in which both lethal and non-lethal UAVs may be encountered by friendly surface forces is examined to determine the elements of UAV operation which may be exploited in defense against UAVs. Two probability models of the air defense endgame are developed to examine the potential lethality of hypervelocity rocket anti-UAV weapons. These models are used to determine the detonation distance which maximizes the probability that a single hypervelocity rocket kills a UAV. Data used in this study are synthetic to prevent disclosure of classified and proprietary information and allow wider distribution of this thesis.

PREDICTING COAST GUARD ENLISTED ATTRITION

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This study examines enlisted attrition behavior for the U.S. Coast Guard and develops a model that projects attrition figures. Survival analysis techniques are used to analyzed the empirical attrition behaviors associated with an individuals sex, race, marital status, and military occupational skill (MOS). In this study males tend to have higher survival probabilities than females, non-caucasians higher than caucasians, and married persons higher than those not married. Aviation MOSs have the highest survival probabilities and technical MOSs have the lowest. Modelled survivor functions are developed for two paygrades because each contain small personnel inventories. These modelled survivor functions do not fit the data as well as desired but are nonetheless used pending the development of sharper alternatives. Finally a counting model based on the Binomial Distribution is developed that projects monthly enlisted attrition figures.

A FRAMEWORK FOR INCORPORATING BATTLEFIELD PURPOSE AND INTELLIGENCE

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This thesis involves a methodology for the development of stand-alone artificial intelligence programs for inclusion in a yet to be developed theatre level wargame for the Conventional Forces Analysis Division (CFAD) of the Force Structure, Resources, and Assessment Directorate (J-8) of The Joint Staff. It uniquely addresses some of the limitations observed in the Tactical Warfare Model (TACWAR), extending the current research effort at the Naval Postgraduate School. The artificial intelligence programs will simulate the decision-making processes that a theatre level commander would make according to his perception of the environment, aware that his intelligence may be incomplete and possibly incorrect. The decision process is based on military doctrine derived from Clausewitz, Jomini, and Napoleon, and involves allocating reconnaissance assets, acquiring and validating intelligence data, maneuvering forces, command and control, and assigning specific mission objectives.

A NAVAL SHIPYARD OPTIMAL DRYDOCK LOADING AND CAPACITY UTILIZATION MODEL

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The Naval Shipyard Optimal Drydock Loading and Capacity Utilization Model presented in this thesis is a tool to optimally load the Naval Shipyard's drydocks. The problem is constrained by the length, type and timing of each ship's required maintenance; current and projected capabilities of existing drydocks; current load of the drydocks; and the requirement to perform maintenance on the drydocks. Prior to this model, the Navy used a suboptimal, manual procedure that took one to two weeks to perform. This inefficiency became critical when an Assistant Secretary of the Navy requested a drydock capacity utilization study, requiring optimal loadings under numerous scenarios. An optimization model which lacks limiting assumptions, allows easy modification of input data and is capable of quick analysis of drydock loading scenarios was developed and executed fast enough to provide timely answers. It is implemented via the *General Algebraic Modeling System (GAMS)*. Data management and interface with the GAMS software is controlled via the *Naval Shipyard Drydock Loading and Capacity Utilization Program* (a stand-alone program written in Microsoft QBasic).

A MULTILEVEL APPROACH TO MINIMAL COST NETWORK FLOWS

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This thesis presents an exploration of the application of multigrid/multilevel techniques to a non-geometric long transportation problem. An introduction to multigrid is given, and specifics of how it is applied to this minimum cost network flow problem are explored. This research shows that multilevel techniques can be applied to network optimization problems. Further, since a previous restriction is removed by transferring the problem from a physical space to a cost space, the techniques can be applied to a broader range of problems. Both a multilevel V-cycle and a Full Multigrid (FMG) algorithm are implemented. Various strategies for restriction and local relaxation are discussed, and comparisons between the methods are made. Experimental results are given. Directions for future work include investigation of graph theoretic aspects of the problem, implementation of a regular grid overlay of the domain, exploration of a fast adaptive composite (FAC) grid algorithm, and development of a full approximation scheme (FAS) algorithm.

REALIGNMENT OF THE U.S. ARMY RECRUITING COMMAND

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This thesis addresses two problems of concern by the U.S. Army Recruiting Command: the realignment of recruiting battalions and companies. For the realignment of the recruiting battalions, this thesis identifies four realignment criteria: (1) Proper trade-off between size and density; (2) State ownership; (3) Adequate command presence; and (4) Robustness with respect to shifts in population. In addition, it demonstrates that the realignment based on state boundary satisfies the four criteria and is a strong candidate for implementation by the command. For the realignment of recruiting companies, this thesis provides an optimization model to realign the companies and two statistical forecasting models to predict the size of the future recruiting market in each battalion. When implemented, the combination of the optimization and statistical models can assist the staff members at the Recruiting Command in the realignment of their recruiting companies.

DDG 51 OPERATIONAL EVALUATION: MEASURES OF WORKLOAD FROM COMBAT INFORMATION CENTER COMMUNICATION PATTERNS

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This thesis analyzes 2,700 verbal transmissions collected from an audio tap on DDG 51's CIC internal communication network during the ship's OPEVAL. The frequency and duration of these voice transmissions are analyzed to explore for systematic changes. These changes are associated with different workload levels and the levels of stress induced by eight simulated combat scenarios. The data shows that CIC team member communication patterns varied as a function of workload. The use of verbal communication patterns as unobtrusive, noninvasive measures of workload in operational settings is discussed and recommendations are made to further develop these measures.

FITTING AND PREDICTION UNCERTAINTY FOR A SOFTWARE RELIABILITY MODEL

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The cost of system operational testing is steadily increasing. It is desirable for the software manager to know if the software is sufficiently well developed or reliable to support such testing. Current software reliability models provide only point estimates of the mean time to next failure or expected number of errors to occur in additional testing time. The goal of this thesis is to take into account prediction uncertainties of a software reliability model. Bootstrapping is used to provide the software manager with confidence limits of the predicted expected number of faults to occur for additional testing time. The results can be particularly useful to a software manager who has to answer a subjective question: is the software reliable enough to support system operational testing? A range of predicted expected number of faults will be of more use to a software manager, who has to justify the answer to this question, than just a point estimate. Two software fault data sets are analyzed with this technique emphasizing how a software manager should analyze the results.

AN OPTIMAL ALLOCATION OF RECRUITER AND FACILITIES IN THE 12TH MARINE CORPS DISTRICT

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This thesis studies category I-IIIA all-service accessions at the county level in the 12th Marine Corps District. A production function is presented to model Marine Corps accessions in the 12th District using Propensity weighted Qualified Military Available (PQMA) and the number of recruiters. The recruiting force is allocated according to this nonlinear production function and a "greedy" algorithm to obtain an integer, heuristically optimal allocation. Each recruiting facility's value is determined by its number of recruiters and the PQMA in the county. A 10% recruiting facility reduction plan is proposed by using an optimal facility allocation model that maximizes the pool of aptitude category I-IIIA potential enlistees. Finally, a determination of the "best" facility manning level is presented as a recruiter assignment decision aid. The recommendations are: 1) align the recruiting force to exploit the location of aptitude category I-IIIA individuals by using the county recruiter allocation model, 2) use the facility reduction model which maximizes PQMA to close excess recruiting facilities, and 3) attempt to operate two recruiter facilities as the preferred manning level and consider further research on the optimal allocation of the entire Marine Corps recruiting force.

AN OPTIMIZATION MODEL FOR ARMY PLANNING AND PROGRAMMING

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A major goal of the United States Army modernization strategy is to improve its warfighting capabilities. In executing its mission as the architect of the future Army, the Training and Doctrine Command (TRADOC) has used a heuristic capital allocation algorithm to recommend which candidate Army modernization actions to fund in the development of the Long Range Army Materiel Requirements Plan (LRAMRP). The goal of this thesis is to develop a flexible, responsive, multi-objective, optimization model to replace the existing heuristic capital allocation algorithm. This model maximizes potential warfighting benefits derived from competing Army candidate modernization actions subject to multiple national and Department of the Army goals and constraints. Additionally, this study demonstrates the fast prototyping capability of a weighted, goal programming approach to a multiple objective capital budgeting problem formulated with the General Algebraic Modeling System (GAMS). The model will be implemented by the Army's TRADOC Analysis Command (TRAC) Operations Analysis Center (OAC) as a tool in designing overall optimal Army investment strategies.

SCHEDULING UNDERWAY REPLENISHMENT AS A GENERALIZED ORIENTEERING PROBLEM

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The replenishment of a dispersed battle group requires logistic ships to travel long distances between ships in the battle group. When operational requirements limit the amount of time that can be spent conducting replenishment, decision makers must select which ships to replenish based on the amount of time needed to transit between ships, and the combat value added to the battle group by replenishment. With proper assumptions, this problem is analogous to the Generalized Orienteering Problem. A dynamic programming algorithm is developed using this approach and tested against a set of test problems. The algorithm is capable of scheduling replenishment using both Delivery Boy, or Circuit Rider tactics. The results indicate that the algorithm runs quickly enough to be useful for scheduling underway replenishment in operational situations.

COUNTERING THE THIRD WORLD MOBILE SHORT-RANGE BALLISTIC MISSILE THREAT: AN INTEGRATED APPROACH

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The Persian Gulf War introduced a new, highly effective threat in the form of the mobile short-range ballistic missile (SRBM). The non-guided SCUD missile proved to be most effective in the political arena as Iraq continually targeted Israel in an attempt to force them into the conflict through retaliation. Although this Iraqi objective ultimately failed, a price was paid by the Coalition forces. A significant percentage of Allied air sorties were diverted to search for fixed and mobile SCUD launch sites. The mobile launchers proved to be highly elusive as post-war analysis has shown little or no success in countering them. Post-war research and development continues to focus on the improvement of post-missile-launch tactics used during Desert Storm to counter the mobile launchers. This thesis introduces an integrated approach to the problem which stresses the inclusion of mobile launcher prosecution prior to weapon release. The general principles of anti-submarine warfare (ASW) are suggested as a structure to build an effective mobile SRBM counter effort doctrine. The benefit of pre-hostility intelligence and pre-missile-launch prosecution, the backbone of successful ASW, is revealed through the analysis of a circulation model which reflects the standard operations of a third world mobile missile launcher during hostilities. A decision model is constructed and analyzed to give insight into the development of pre-hostility intelligence policies.

SCHEDULING COAST GUARD DISTRICT CUTTERS

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The United States Coast Guard is organized by Atlantic and Pacific areas, which are further subdivided into districts. Each district assigns cutters (ships) of length 180 feet or less into weekly statuses. The resulting cutter schedules reflect the district's level of readiness to respond to such emergencies as search and rescue, law enforcement, and pollution response. The First Coast Guard District has one of the largest scheduling problems, assigning each of 16 cutters to one of six weekly statuses. The First District's quarterly schedules must adhere to a number of guidelines which ensure patrol coverage, enforce equitable distribution of patrols, and restrict consecutive cutter statuses. This thesis formulates and solves the quarterly scheduling problem as an elastic mixed integer linear program. Face valid schedules, which are superior to actual schedules for all measures of effectiveness considered, are obtained within 15 minutes on a 486/33 Mhz personal computer using a commercially available integer programming solver.

USE OF MULTIPLE TRACKING DATA IN THE CALIBRATION OF SHORT BASELINE ARRAYS

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The calibration problem of a Short Baseline Underwater Vehicle Tracking Range is concerned largely with the coherency of path as the target vehicle passes from the domain of one array into that of another. The arrays are placed approximately in a hexagonal mesh. Thus there are regular locations (triple overlap regions) where the vehicle is tracked simultaneously by three separate arrays. Longbase methods can be used to locate the vehicle in these isolated regions. Presumably the four determinations (three for the individual short baseline arrays and one for the long baseline) can be used to locate the arrays and help calibrate the range. This thesis contains a feasibility study for this idea. Vehicles are placed at known locations in the triple overlap regions. A sequence of correction actions is postulated and the algorithms have been programmed. It appears to work quite well within the confines of this idealized study.

PACSIM: USING SIMULATION IN DESIGNING A COMMUNICATIONS SATELLITE

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The Naval Postgraduate School is developing a small, experimental, low-orbit packet radio satellite for launch in 1995. It is the first for use by the amateur radio community to implement spread spectrum communications. To aid in designing the spacecraft's communications network, we have developed an object-oriented, reusable, high resolution simulation model, PACSIM, which: (1) fully emulates the activity of users in the network; and (2) has the ability to provide information on these measures in several thousand different scenarios. We describe this satellite-user network and elucidate the strong interdependence of design factors. Simulation results are presented. Also, we critique the use of simulation as a decision aid for assessing the effect of design decisions such as data transfer rate, spacecraft memory allocation for store-forward and capture protocol among other factors.

A REAL-TIME SHARPENING OF NOGAPS PREDICTIONS OF MID-LATITUDE CENTRAL PACIFIC CYCLONES

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A Modifying Model is developed which sharpens the 24 hour position forecast issued by the Navy Operational Global Atmospheric Prediction model (NOGAPS) 24 hours into a selected, mid-latitude, Central Pacific cyclone. The technique involves measuring cyclone characteristics within the first 24 hours and using these values in regression equations to provide improved forecasts for the next 24 hour position forecast. Generally, the modified position forecasts are to the left and ahead of the NOGAPS position forecasts along the anticipated track of the cyclone. Probability ellipses about the Modifying Model estimates cover about 50 to 60 percent of the area of the corresponding NOGAPS probability ellipses. Only cyclones in the deepening phase (central pressure decreasing) or forecast to be in the deepening phase are utilized in the data base. The Modifying Model is sufficiently simple that shipboard personnel can make the computations in real time.

DEPARTMENT OF DEFENSE IN THE WAR ON DRUGS: AN OPTIMIZATION MODEL FOR COUNTER-NARCOTICS ASSETS

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This study explores the optimization method of simulated annealing for use in an analytic tool for counter-narcotics analysis. A model is developed, employing RAND Corporation's Simulation of Adaptive Response model as an objective function evaluator, which optimize interdiction asset locations relative to a sample smuggling network in the Caribbean region. In addition to asset location optimization, the response of the model to changing numbers of assets is also tested. Results indicate that this methodology has potential for use in the counter-narcotics program, and perhaps other network interdiction applications. Further research and testing are recommended. Military drug interdiction and the smuggling threat are discussed.

AN INTRA-THEATER TRANSPORTATION SYSTEM SIMULATION TO ASSIST LOGISTICIANS IN TRANSPORTATION RESOURCE PLANNING AND IMPLEMENTATION

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Transportation resource planning and implementation within a theater of operations have always been challenging for logisticians. This was especially true during Operation Desert Storm, where new lessons were learned because of a scenario different than any other experienced. What was needed was a transportation asset-focused model that would allow logisticians to plan more effectively for current and future transportation system requirements. The focus of this thesis is the development of the Intra-Theater Transportation System Simulation (ITTSS). ITTSS is an object-oriented simulation model, which was developed to simulate a complete transportation system where units consume supplies, supply points resupply, and assets deliver the supplies. ITTSS can also be used to schedule specific missions of moving cargo from one location to another. Both modes can be run separately or together. A variety of input parameters concerning supply points, motorpools, maintenance facilities, fuelpoints, convoys and the operations performed can be adjusted to fit any specific scenario. The measures of performance produced by the model include the daily amount of cargo moved, time required to move cargo to a certain location, and the availability and utilization rates of vehicles. ITTSS is designed to run on a personal computer, using the PC-OS/2 version of MODSIM II, the OS/2 1.2 operating system, and Microsoft C 5.0.

DECISION AID FOR PLANNING THE MAINTENANCE OF ELECTRONIC EQUIPMENT IN THE GERMAN ARMY

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In the early stage of the Weapons Acquisition Process (Concept Exploration and Concept Demonstration/Validation Phases) no exact and reliable data are available about expected Mean Times Between Failures (MTBF) and Mean Times to Repair (MTTR) for both the components of a new system or the new system itself. Nevertheless, appropriate decisions have to be made about the number of maintenance facilities at certain military command levels, about the needed quantity of (military and/or civilian) maintenance personnel, and about adequate spare stock levels at the appropriate locations. Wrong planning in this early stage can cause a degradation of the new system's future availability. This is problematic especially with electronic equipment, because maintenance personnel have to be highly specialized, and can not be replaced and retrained as easily as support personnel for trucks or tanks. A decision aid for the early stages of the acquisition process is needed that offers insight into the behavior of a multi-indenture level electronic system within a three echelon maintenance system, develops alternatives for upcoming decisions, and finally provides information about sensitive factors and their possible tradeoffs, essentially used in budgetary discussions. The purpose of this thesis is the exact definition of all relevant factors pertaining to the necessary decisions, the review of existing models and tools and their review for applicability. Because the modification of existing programs can not solve the whole scope of the problem due to the use of early generation computer languages, and due to the necessarily new and different approach to the topic, a new simulation program has to be developed. Using object-oriented simulation language MODSIM-II, first steps toward this program are made, but remain to be improved and completed in further research work.

DIRECT FIRE SYNCHRONIZATION

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This thesis analyzes defense in sector missions adapted from the National Training Center and conducted with the Janus(A) high resolution combat model to check for relationships which influence direct fire synchronization. This analysis should enhance the monitoring of unit performance in the area of concentration or massing of fires consistent with the commander's intent. The combat fighting vehicle, which combines the characteristics of mobility with high volumes of firepower, dominates the desert battlefield and is the focus of this study. Graphical methods and analytic techniques are developed to describe the battle in terms of direct fire synchronization and a mission measure of effectiveness (MOE). This research is being conducted under the U.S. Army's Battle Enhanced Analysis Methodologies (BEAM) study, which is developing objective doctrinal AirLand battle measures and visual displays to enhance training analysis. The thesis also describes the training environment of the NTC, defense in sector doctrine for both the U.S. Army and the U.S. Marine Corps with emphasis on asymmetries, and threat offensive doctrine.

AN EXAMINATION OF THE PERFORMANCE OF A NATURAL TRUNCATION POINT AND ACCEPTANCE RULE FOR A CURTAILED WALD SEQUENTIAL SAMPLING PLAN WITH BERNOULLI PARAMETERS

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This paper examines the performance of a proposed truncation and acceptance rule for the Wald Sequential Probability Ratio test for Bernoulli parameters, and the rule's influence on errors of the first and second kind as well as the average number of items sampled for inspection. The proposed truncation and acceptance rule suggests that there exists a natural truncation point for every Sequential Probability Ratio test such that the desired error probabilities are not exceeded or that one of the true errors is smaller than desired and the other will be exceeded by an insignificant amount. A computer program is used to simulate the sampling process and provide estimates of the true values of a plan's Operating Characteristic curve, its average sample number, as well as the probability of implementing the truncation and acceptance rule. Results suggest that truncation and rejection of a lot at the natural truncation point will maintain a plan's desired Operating Characteristic curve. The cases examined also suggest that any modification to the natural truncation point truncation and acceptance rule may cause an unacceptable deviation from the desired Operating Characteristic curve. Finally, a linear equation was developed which provides an estimate of the upper limit on the probability of implementing a truncation and acceptance rule, and that in most cases, this upper limit is less than 0.15.

MODELING THE SEARCH FOR A RANDOMLY MOVING TARGET BY A PATROLLING SEARCHER

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This thesis develops a model, called Area Motion Search (AMS), that determines the detection probability for a patrolling sensor searching for a randomly moving target in a fixed area. The AMS model reduces to exhaustive search when the target is stationary and to random search when the searcher is stationary. Thus, AMS is a bridge between these two often used models in search theory, and provides a unified treatment of both.

EFFECT OF VARIABLES INDEPENDENT OF PERFORMANCE ON PROMOTION RATES TO MAJOR, LIEUTENANT COLONEL, AND COLONEL IN THE MARINE CORPS

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The models developed in this analysis provide a tool for Marine officers who need a quick, reliable promotion predictor to assist in career assignments or choices. These models use several easily obtained factors to forecast selection rates for promotion to Major, Lieutenant Colonel, and Colonel. Specifically, factors which can be used to predict selection rates to all the aforementioned paygrades are MARITAL STATUS, ATTENDANCE AT AN APPROPRIATE LEVEL PROFESSIONAL SCHOOL, and ATTAINMENT OF A POSTGRADUATE DEGREE. Duty assignment, commissioning source, and personal awards are significant factors, also, but not universally. Significant by their lack of influence on selection rates are RACE, SEX, and COMBAT EXPERIENCE. Other factors also studied but not mentioned in the abstract are discussed in the body of this analysis.

A FORECASTING MODEL FOR PROCUREMENT ADMINISTRATIVE LEAD TIME

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This thesis objective is to develop a model to forecast the cost and the lead time in awarding a contract. All available, pertinent contract data was obtained and utilized from the Procurement Department of Naval Air Warfare Center Weapons Division, China Lake, California. The data was limited to the years 1989 through 1991. The actual cost of letting a contract has not been recorded, so a prediction model was fit only for the Procurement Administrative Lead Time (PALT). Cost is believed to be positively correlated with PALT. Explanatory data available for each contract were: contract amount, contract type, contract description and competitive nature. A "complexity score" was also available, which was determined by procurement personnel. Since many of the same variables used to compute complexity were also used to predict PALT, those variables were verified as possible predictors of cost by building a prediction model for complexity score. The following variables served as good predictors of PALT: contract amount, contract description and contract type. It was also determined that the competitive nature of the contract had little impact on PALT. With this data, it is difficult to forecast PALT precisely for a given contract. However, with the recommended collection of additional data, PALT and the cost of a contract should become predictable with increasing confidence.

INTERACTIVE NAVAL GUNFIRE SUPPORT TRAINING

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The goal of this thesis is to develop an interactive computer system for Man-In-The-Loop Naval Gunfire Support (NGFS) training. In attaining this goal, it provides the end user with the full range of exercises a ship sees at the NGFS ranges. The emphasis is on coordinated teamwork to facilitate a seamless transition from the training (non-firing) environment to live-round firings. The benefits are three-fold. First, a more cohesive primary team will be developed. Second, the declining DoD budget demands that fewer training rounds are expended and that the training and maintenance budget be reduced. Finally, a more efficient use of range time will result from better shipboard teamwork. The NGFS training model encompasses the five testable scenarios from COMNAVSURFLANTINST 3570.2D (Gunsmoke) and incorporates the appropriate mix of point, area, and counter-battery fire. A built-in umpiring capability impartially monitors time-line events and awards the appropriate points and penalties. A training report is generated to document the exercise and compare results to historical performance. A statistical analysis of improvements by *milestones in mission* vs. the norm is done to emphasize areas in critical need for improvement.

PERFORMANCE MEASURES FOR U.S. PACIFIC FLEET SHIP INTERMEDIATE MAINTENANCE ACTIVITIES

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The subject of this thesis is performance measures for U.S. Pacific Fleet Ship Intermediate Maintenance Activities (IMAs). It examines measurement data collected by the Maintenance Resource Management System (MRMS) and the Monthly IMA Utilization Report. Also, new timeliness measures of effectiveness are defined. The purpose of the study is to present, in one document, a description of all currently collected IMA performance measures, recommendations for other performance measures, and a statistical analysis of the performance measures to determine if they show performance differences between the Intermediate Maintenance Activities.

AN OBJECT-ORIENTED APPROACH TO RELIABILITY AND QUALITY CONTROL MODELING OF THE MAINTENANCE EFFORT FOR U.S. MARINE CORPS GROUND COMBAT EQUIPMENT

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The U.S. Marine Corps conducts maintenance on combat essential, readiness-reportable ground combat equipment on a continuous basis. This maintenance effort is managed through a standardized database management system, known as the Marine Corps Integrated Maintenance Management System (MIMMS). A method is developed in this thesis which provides the operational commander with an empirically based maintenance forecasting system, using information currently being collected by the MIMMS system, and producing consistently sharper local estimates of individual equipment behavior. With this method, a ground commander can specify a predetermined equipment mixture and an expected exercise duration, based on a general geographic location, and be provided estimates of equipment availability. Thus, he can better manage his maintenance effort and allocation of maintenance resources. Forecasting is done by simulating future repair and failure times from models estimated using available maintenance history data. The simulation is configured to be managed in the MODSIM II simulation language as a series of alternating state changes, for each equipment item, up to a preselected stopping point, which would represent a projected deployment date. Estimates of equipment operational availability are computed from monitored mean failure and repair times in each state. Compilation of the prototype version, simulating six items through three complete transaction groups, is completed in approximately 15 minutes, and execution on an IBM compatible 386-25 based machine concludes in approximately 10 minutes.

EVALUATION OF DIGITAL COMMUNICATIONS USING THE MARINE CORPS COMMUNICATIONS ARCHITECTURE ANALYSIS MODEL

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The United States Marine Corps (USMC) is currently evolving to digital communications. This change has created a need for an analysis tool capable of analyzing digital architectures. Traditional communications are being supplemented, and in some cases, replaced by automated systems like the Marine Tactical Command and Control System (MTACCS). Older equipment, the PRC-77 and AN/VRC-12 family of radios, is being replaced by lighter, more efficient equipment like SINCGARS and the Digital Communications Terminal (DCT). Protocols like the Marine Tactical System (MTS) Broadcast Protocol are being implemented to orchestrate this new way of communicating. To assist in the transition, this thesis modified the Marine Corps Communications Architecture Analysis Model (MCCAAM) so it could measure the impact of changing from voice to digital communications. The Fidelity Enhancement Process (FEP), a comprehensive methodology for model upgrades, was used to systematically modify the model. The model's usefulness is demonstrated in an analysis example by comparing three separate partially digital communications architectures.

GRAPHICAL METHODS FOR DEPICTING COMBAT UNITS

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Analysis of battlefield training is being enhanced with computer screens that display maps of the battlefield. At the National Training Center (NTC), Fort Irwin, California, training battles are digitally recorded to be analyzed later by military officers, tacticians and analysts. A large screen computer generated map display is used to unfold the battle one piece at a time to see what caused the forces to achieve success or failure. As an improvement to current battlefield displays, graphical methods and techniques are presented for aggregating the elements of combat units. The techniques focus on locating a unit, graphically summarizing the movement of a unit, and graphically depicting a unit's dispersion on the battlefield. These methods are intended for use in post-battle analysis software platforms like the ones used at the NTC.

A COST ESTIMATION STUDY OF TH-57 UPGRADE PROPOSALS

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This thesis uses cost estimation techniques and computer models to analyze complex issues associated with upgrading the Navy's helicopter trainer, the TH-57, which is approaching its service life limit. A decision regarding a TH-57 upgrade is needed to support the current training syllabus. The analysis revealed that without a comprehensive long-range plan, the Training Command will ultimately face a no-win situation; that is, reducing either its pilot training rate or syllabus flight hours. A pilot training rate reduction will create a shortfall of fleet pilots and a flight hour reduction may adversely impact flight training quality. The problems identified in the Chief of Naval Air Training's Tentative Operational Requirement were addressed. Several aircraft configurations were evaluated and four recommendations were made to ensure an effective upgrade.

A REVISED LOWER CONFIDENCE LIMIT PROCEDURE FOR THE RELIABILITY OF COMPLEX QUASI-COHERENT SYSTEMS

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This thesis describes a procedure for computing a lower confidence limit on the reliability of a quasi-coherent complex system using test data on its components. The failure times of the components are assumed to have either exponential or Weibull distributions with unknown parameters. The accuracy of this procedure is evaluated using computer simulation for various system structures and sets of parameter values for the assumed distributions. This thesis is an extension of a thesis by Kah Chee Yee in that it uses a different equation for the estimate of the shape parameter in the Weibull distribution than Yee used, and it evaluates the procedure for a larger collection of system structures.

SEQUENTIAL ESTIMATION OF OPTIMAL AGE REPLACEMENT POLICIES WHEN DISTRIBUTION OF LIFETIMES IS PHASE TYPE

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Optimal age replacement policies are designed to cut down system failures and minimize maintenance cost. By scheduling planned replacements, a system is replaced at age ϕ^* or at failure, whichever comes first, and the cost of replacement before failure (planned) is less than the cost after failure (unplanned). In this thesis, the distribution of lifetimes is a known, increasing failure rate phase type distribution. To find the optimal age of replacement, the parameters of the underlying phase type distribution must be estimated. An optimal age sequential estimation procedure is developed. In particular, the phase type distributions parameters are estimated using a matching moments nonlinear programming approach. Since there are many parameters associated with phase type distributions and the distributions include matrix exponential terms, the parameters are in general difficult to estimate. A specific case where the phase type distribution has initial probability vector $\alpha=(1,0,0)$ is studied for different sample sizes and compared with a similar nonparametric procedure.

BRIGADE AUTOMATED MISSION ASSIGNMENT MODEL FOR THEATER LEVEL SIMULATION

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This thesis models the interaction of nonlinear relationships based upon gathered expert judgments. The model developed reproduces a portion of the military expert's mission assignment decision-making process. Specifically, this thesis illustrates a method of combining the influences of **EXPERIENCE, LOGISTICS, PREPARATION TIME, CONTINUOUS OPERATIONS, MISSION, ENEMY, TERRAIN TYPE, VISIBILITY, ENGAGEMENT RANGES** and **TRAFFICABILITY** with varying brigade task organizations in order to identify the most mission ready brigade based upon expert military judgement for use within a theater level simulation. The model produced by this study uses the Analytic Hierarchy Process (AHP) to obtain expert military judgements through relative scale pairwise comparison techniques and to recreate the results of those judgements. To fully implement the model, all situations require additional expert judgements and the model requires validation.

UNITED STATES MARINE CORPS
MOBILE ELECTRIC POWER OPTIMIZATION MODEL

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This thesis develops a methodology that can be used to determine the type and quantity of mobile electric power generators necessary to meet current and future total Marine Corps electrical demand. This determination is a major part of the formal Marine Corps Mobile Electric Power Requirements Analysis. It is conducted in two steps. The first step involves application of the Army's Belvoir Generator Allocation Program (BGAP), a computer program that determines individual unit generator requirements, to individual Marine Corps units. The second step uses the BGAP results as input and determines the total force generator requirements and allocations over time using the Marine Corps Mobile Electric Power Optimization Model (MCMEPOM), a new model developed in this thesis. MCMEPOM is a non-consumptive demand, multiperiod linear programming model implemented with the General Algebraic Modeling System (GAMS).

DEVELOPMENT AND COMPARISON OF
TACAMO ICON DESIGN FORMATS

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The purpose of this study was to develop and evaluate a set of icons for the next generation message processing system for the TACAMO airborne strategic communications platform. An icon set for a proposed interface was developed through the use of an icon production method test, that is, potential users designed candidate icons that were meaningful to them. These icons were then refined for discriminability via input from a user survey. To determine if well-developed icons with alphanumeric labels yield a significant performance advantage over the same icons without labels, an experiment involving trained users was conducted using a response time model. Subtractive logic was used to measure icon identification times as a function of whether they were or were not labeled. When speed of performance and rate of errors were compared, labeling of icons resulted in significantly longer response times, yet did not result in fewer errors for the tested icon set. It is recommended that the unlabeled set of icons be used for TACAMO's next generation message processing system, and that the icon production method be used more widely to involve users in interface design.

NAVY OBSTETRICS/GYNECOLOGY PHYSICIAN ALLOCATION MODEL

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The availability of Obstetrics/Gynecology (OB/GYN) physicians is one of the most critical manpower issues facing Navy medicine. Insufficient recruitment efforts, coupled with poor retention rates have resulted in only 76.1% fulfillment of the authorized billets, which by FY-97, is projected to fall to 57.5% fulfillment. To meet the demand for OB/GYN services required by military beneficiaries, optimal allocation of existing assets as well as alternative means for delivering care must be fully examined. This thesis develops a mixed linear, integer program which optimizes the allocation of these scarce physician resources. Computational results are reported for realistic scenarios demonstrating the model's applicability. Model results consist of a recommended mix of OB/GYN provider assets that is different, in many instances, from the current staffing of Navy OB/GYN clinics. Additionally, reported results recommend closure of OB/GYN clinics where demand does not justify continued operations.

AN OBJECT-ORIENTED SHIP-TO-SHORE MOVEMENT ANALYSIS MODEL (CUTTER)

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Master of Science in Operations Research-September 1992
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This thesis documents the design and implementation of a simulation of the Ship-To-Shore movement phase of the amphibious assault in a modern, object-oriented, process-based simulation language called *MODSIM II* by CACI Corporation of La Jolla, California. The main intent of the simulation is to build a model that will allow the Requirements, Plans and Programs Branch (RP&P), Headquarters, United States Marine Corps (HQMC) to quantitatively compare proposed replacements for the assault aircraft and amphibians currently used in the conduct of the ship-to-shore phase of the amphibious assault. Candidates from the Medium Lift Requirement (MLR) program are compared to identify that mix of aircraft which provides the most rapid build-up of combat power ashore.

AN INTERSERVICE COMPARISON OF RECRUITING EFFICIENCY USING DATA ENVELOPMENT ANALYSIS (DEA)

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As budget and force reductions continue, Navy recruiting must become more efficient, using fewer dollars and resources. In an effort toward achieving this goal, this thesis proposes two procedures to evaluate the efficiency of Navy recruiting. Both procedures are based on two Data Envelopment analysis models. One procedure assumes that all inputs are discretionary and the other does not. To demonstrate their effectiveness, the two procedures were implemented in the General Algebraic Modeling System (GAMS) and used to analyze the efficiency of recruiting districts from the four services: Navy, Marine Corps, Army and Air Force.

A DATABASE APPROACH TO AIRCRAFT CARRIER AIRPLAN PRODUCTION

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This thesis addresses a known problem in Carrier Aviation. The problem is the constant duplication of effort writing the carrier airplan. This problem is common to all airwings and results in late airplan publish times which reduce the combat effectiveness of the battlegroup. The analysis of the airplan is accomplished through the establishment of a database of carrier airplans. The database interacts with a spreadsheet designed to help Strike Operations aboard the carrier streamline the process of writing the airplan. The prototype model developed accepts inputs from the Assistant Strike Operations Officer. The model searches the database for airplans that conform to his inputs and provides candidate airplans for review. Once an airplan is selected, an airplan template, in spreadsheet format, can be altered to meet any required changes. Once changed to meet specific tasking the final product can be saved. After a period of operations the database search file can be updated to mold the database to a specific ship and airwing's standard operating routine.

ANALYSIS OF THE COMMAND AND CONTROL NETWORK MODEL AND LINKAGE MECHANISM WITH FORCE EVALUATION MODELS

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Newly emerging functional area models designed to simulate the activities of individual battlefield operating systems are generating challenging new validation issues for Army analysts. From database to output, these new models require testing against real system performance to ensure no significant disparities exist. The Command and Control Network (C2NET) model is a prototype Command and Control Functional Area Model (C2FAM) and exemplifies this validation challenge. This paper examines the C2NET database, input distributions, and linkage mechanism with a force evaluation model as part of C2NET's continuing validation effort. The nonstationary Poisson process is examined and used to develop hypotheses about input distributions linking the evaluation model's tactical scenario with C2NET's input parameters and existing database. Fuzzy set theory is then examined with applications for using C2NET output as input for an evaluation model. Areas for further research are discussed.

MODELING CLOSURE OF ARMY MATERIEL COMMAND INSTALLATIONS: A BI-CRITERIA MIXED INTEGER PROGRAMMING APPROACH

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The Army is reducing and reshaping its force structure to adapt to the Nation's changing defense needs and budget constraints. In response to these changes, Army Materiel Command (AMC) will submit facility realignment and closure recommendations in FY93 and FY95. This thesis develops a bi-criteria mixed integer programming model with the objectives of minimizing operating costs and maximizing a measure of military value to assist AMC in the generation of alternative realignments. Realignment of depot maintenance, research and development, test and evaluation, and administrative functions are considered on 32 AMC installations. An extensive empirical study demonstrates the applicability of the developed approach.

A COMPARISON OF ENGAGEMENT RANGES FROM THE M1A2 EARLY USERS TEST AND EXPERIMENTATION TO THE JANUS(A) COMBAT SIMULATION MODEL

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The purpose of this thesis is to assist in the accreditation of the Janus(A) combat model for the post-test modeling phase of the Army's Model-Test-Model Concept. Specifically, the First Shot Engagement (FSE) and Opening Round Engagement (ORE) ranges from the September 1991 trials of the M1A2's Early Users Test and Experimentations are compared to similar ranges generated by the Janus(A) simulation model. The location and distributions of these ranges are compared using nonparametric procedures. A regression model using the results of the simulation model to predict the ORE range was developed and compared to the actual ORE ranges. The effects of the systematically varied test factors, such as a force's tactical posture and light conditions were also studied to determine if the simulation model could accurately predict their effects on the field test engagement ranges. An important conclusion of this thesis is that Janus(A) generates different engagement ranges than those observed in the September 1991 operational field test and that the model was unable to accurately predict the effects of the test factors.

ANALYSIS TOOLS FOR UNITED STATES AIR FORCE SORTIE OPTIMIZATION AND MUNITIONS PLANNING

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Computer-based tools are designed and implemented to improve the quality and speed of the analysis of results from large scale optimization models These tools are needed to manage the voluminous output generated by these models. This approach is applied to the United States Air Force mode HEAVY ATTACK which is a large-scale non-linear optimization program used to plan air-to-ground munitions requirements. A single execution of the model produces about 4,500 lines of results. The HEAVY ATTACK decision-making process is studied and specific analysis tools are designed and implemented with a spreadsheet program on a personal computer.

AN EVALUATION OF VARYING DISTRIBUTION POLICIES FOR THE COMMANDER'S INDEPENDENT THERMAL VIEWER ON U.S. ARMY MAIN BATTLE TANKS

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The U.S. Army's main battle tank, the M1A1, does not possess the enhanced features of the proposed M1A2 tank. Limited production authorization for the M1A2 will result in only 62 M1A2 tanks reaching the Army's inventory. The U.S. Army needs to determine if certain technologies from the M1A2 should be retrofitted to existing M1A1 tanks. The Commander's Independent Thermal Viewer (CITV) is among the most promising add-ons for the M1A1. A scheme to test whether addition of the CITV alone to the M1A1, without adding any of the other M1A2 improvements, is conducted to measure lethality, survivability, and detection performance. The JANUS(A) combat model is used to collect data. Battalion and squadron level scenarios were conducted for both Central Europe and Southwest Asia during both day and night conditions. Measures of performance are analyzed in each of the three areas to determine the influence of the CITV on M1A1 performance.

OPTIMIZATION MODELS FOR UNDERWAY REPLENISHMENT OF A DISPERSED CARRIER BATTLE GROUP

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This thesis presents a classification of basic optimization models for planning underway replenishment of a battle group. In particular, this thesis focuses on two scenarios, *routine* and *rearming*, and considers three replenishment tactics: circuit rider, delivery boy and gas station. Some of the models presented can be classified as (standard) traveling salesman, generalized traveling salesman or orienteering problem. However, several models are further generalization of these problems which have not been previously considered. Computational experiments using four formations from the literature and commercially available software identify problems that are difficult to solve and/or require specialized algorithms.

APPLICATION OF AN INTERACTIVE COMPUTER MODEL TO ANALYZE THE DISTRIBUTION OF U.S. NAVY WARFARE SPECIALISTS AMONG GENERALIST BILLETS

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Advisor: Paul R. Milch-Department of Operations Research

This thesis demonstrates the application of a user-interactive personnel flow forecasting model, FORECASTER, in analyzing the distribution (billet-fill requirements) of U.S. Navy warfare specialists among generalist billets. The development and implementation of the model as used to analyze multiple communities is outlined in detail. Three basic scenarios are utilized to demonstrate the model's flexibility and sensitivity: (1) the "status-quo", or present, distribution; (2) alternative policies with regards to adjustments to tour length; and (3) alternative guidance pertaining to transition probabilities. The results of these analyses demonstrate FORECASTER as a viable tool by which the complexities of multiple personnel community management can be investigated and alternatives considered.

MASTER OF SCIENCE
IN
PHYSICAL OCEANOGRAPHY

ACOUSTIC SENSING OF OCEAN TURBULENCE

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The need for direct turbulence measurements in the upper ocean arise from widespread requirements to correctly parameterize momentum and scalar fluxes across the air/ocean interface. Until recently these observations were limited by a lack of instrumentation capable of measuring the fine-structure velocity field down to dissipation scales. The recently developed CDV package allows simultaneous subcentimeter resolution measurements of temperature, conductivity, pressure, shear and the 3 component velocity field. As part of the development of this system a Monte-Carlo simulation was used to analyze the performance of several spectral estimators of the mean acoustic Doppler shifts, from which the velocity components are derived. The selected algorithms were implemented on a Digital Signal Processor allowing real-time estimation of the velocity, shear and scalar quantities. To verify the performance of the CDV package, it was deployed off Warf 2 in Monterey for 24 hours while simultaneously recording meteorological data. Reynold's stresses, buoyancy fluxes and fine scale stratification were characterized and the surface gravity waves field identified.

COMPUTER SIMULATION OF ACOUSTIC FLUCTUATIONS DUE TO FINESCALE TEMPERATURE PERTURBATIONS MEASURED BY THERMISTOR CHAIN

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Finescale temperature features in the oceanic mixed layer (OML) modify acoustic propagation by perturbing the sound speed index of refraction. A thermistor chain measures temperature from the surface to 250 m with 2 m vertical resolution and 1.85 m horizontal resolution. Thermistor data is converted to high resolution sound velocity profiles for input to an implicit finite difference parabolic equation (IFD-PE) model. The control case is a surface duct with a horizontally averaged sound velocity profile. The IFD-PE model is run with monofrequency sources from 500 Hz to 10 kHz. The acoustic fluctuations and average acoustic pressure are computed each 20 km to a range of 100 km. Acoustic propagation through the temperature varying OML is contrasted with acoustic propagation through the temperature invariant OML. Finescale temperature randomly alters the average acoustic pressure by up to a factor of two and alters acoustic fluctuations by up to a factor of five.

SIMULATION OF ACOUSTIC MULTIPATH ARRIVAL STRUCTURE IN THE BARENTS SEA

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Master of Science in Engineering Acoustics-June 1992
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In support of the Barents Sea Polar Front Experiment (BSPFEX) in September 1992 (Barents Sea Polar Front Group, 1992), the planned 224 Hz tomography signal transmissions from a near bottom sound source to a vertical receiver array consisting of 16 hydrophones were simulated. Acoustic rays were traced to the receiver array at a range of 50 km using the NOAA Hamiltonian Raytracing Program for the Ocean (HARPO). Input to HARPO was a mathematical ocean environment based on historical bathymetric and sound speed data. Acoustic multipath arrival structure was constructed through eigenray searches and estimation of raytube spreading and surface and bottom losses. A resolvabilty analysis of the simulated arrival structure reveals that there are a total of 49 unique resolvable ray arrivals. Among them, 42 are from individual omnidirectional hydrophones and 7 from plane wave beamforming.

MONTHLY MEAN TIME SERIES OF TEMPERATURE AND SALINITY IN MONTEREY BAY, 1951-1991

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Temperature and salinity profile data, collected from different sources over the last four decades (1951-1991), were compiled and processed to obtain monthly mean time series of thermal conditions in Monterey Bay. The results indicate: (1) Near surface low salinity water intruded into the Bay from offshore during January to April, especially during March. (2) Annual cycle of monthly regression T-S curves, obtained by least-squares method, showed "seasons" cycle in the Bay; and missing salinity data can be filled by regression equations of salinity on temperature. (3) Anomalously high temperature water occurred in some years which had two different time patterns. In the upper layer, shallower waters lead in time whereas in the deep water, deeper waters always lead. These two time patterns are believed to be associated with local forcing (weather conditions) and remote forcing (coastal trapped waves) respectively.

RADIATION STRESS SPECTRAL TRANSFORMATION ACROSS THE SURF ZONE

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Shoaling and decay of bi-modal spectra (two distinct frequency peaks and directions) were measured at Santa Barbara Beach, California. Spectral analysis shows that the wave train associated with the lower frequency peak dominates in the surf zone with the high frequency component decaying faster than low frequency component. Mean wave directions were measured for both wave trains with current meters located outside and throughout the surf zone. Errors associated with meter mis-alignment were minimized by numerically rotating the measured mean wave direction of the low frequency wave component to correspond with the predicted refracted direction based on Snell's Law over the near planar beach. Meter re-alignments were then verified by comparing the measured and predicted directions of the high frequency component, yielding an average error of order one degree. The ability to remove rotational errors from in-situ data thereby allows for accurate measurements of the radiation stress transformation across the surf zone.

ANALYSIS OF MONTEREY BAY CODAR-DERIVED SURFACE CURRENTS MARCH TO MAY 1992

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HF surface current radar (CODAR) data from two shore-based radar sites were collected and combined to form vector estimates of the near-surface currents in Monterey Bay from March to May 1992. CODAR-derived currents are measures of the flow in the upper 1 m of the water column. *The springtime mean flow pattern in* the Bay and its variability based on a maximum of 760 three-hourly observations at a nominal 2 km spatial resolution are presented. Results for each month and the canonical day are also shown. The mean patterns show strong southward flowing onshore currents ($\approx$20 cm $\cdot$ s^{-1}) in the outer bay and near zero mean flow nearshore and northwest of Moss Landing. The variability is, however, large with standard deviations typically twice the mean. The canonical day shows strong ($\approx$40 cm $\cdot$ s^{-1}) onshore flow over the entire Bay in the late afternoon giving way to a weaker reverse flow near and northwest of Moss Landing in the nighttime period. These flow patterns combine to produce the observed mean flow. CODAR data show energy at semi-diurnal tidal periods (12.3 and 11.9 hours), diurnal period (24 hours) and longer period (17 days). CODAR data is compared to data from a moored buoy. Low-passed time series are well correlated. Unfiltered time series have higher correlations at diurnal and semidiurnal tidal frequencies. CODAR-derived surface currents and the winds are highly correlated at near-diurnal frequencies corresponding to the daily sea breeze forcing.

TESTING THE ACCURACY OF A THREE-DIMENSIONAL ACOUSTIC COUPLED MODE MODEL

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The three-dimensional coupled mode sound propagation model of Chiu and Ehret (1990) is tested for its accuracy in modeling horizontal sound refraction. This test is achieved by comparing results generated by this model with exact analytic solutions to a parabolic approximation of the Helmholz Equation (Seigmann, et. al., 1990). Specifically, the acoustic wavefields associated with two cases of horizontally variable sound speed are considered. In Case I the sound speed varies only with azimuth, while in Case II there is radial and azimuth variation. The acoustic quantities used for the comparison include the modal modulation envelopes and transmission loss. Errors in the mode amplitude and phase are quantified and the significance of horizontal refraction is discussed.

PREDICTING THE UNDERWATER SOUND OF MODERATE AND HEAVY RAINFALL FROM LABORATORY MEASUREMENTS OF RADIATION FROM SINGLE LARGE RAINDROPS

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Master of Science in Engineering Acoustics-March 1992
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Large raindrops (greater than 2.2 mm diameter) that strike a water surface at terminal velocity are capable of creating bubbles that radiate significant underwater acoustical energy. Previous studies have revealed a positive correlation between underwater sound spectral levels during rainfall and the number of large raindrops present. Therefore, laboratory measurements have been made of the underwater sound generated by large raindrops. Using the laboratory measurements, smoothed energy density sprectra for various sizes of large raindrops are determined. These spectra are then used to compute a predicted underwater sound spectrum due to rainfall for rainfall rates of 15 mm/hr and 100 mm/hr, assuming an exponential (Marshall-Palmer) raindrop size distribution. The resulting spectra are compared to underwater sound spectra measured at sea during periods with similar rainfall rates. The predicted rainfall spectra are comparable to the measured rainfall spectra. Possible reasons for differences are discussed. An inversion technique for obtaining the raindrop size distribution from the rainfall acoustical spectrum is presented. An alternate approach for obtaining the required inversion matrix is suggested for future work.

THERMODYNAMIC AIR/OCEAN FEEDBACK MECHANISMS IN THE EQUATORIAL PACIFIC

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The occurrence of the El Nino Southern Oscillation (ENSO) has been studied from numerous air-ocean interaction aspects, yielding theories implying a positive-only correlation between the time rate of change of sea surface temperature anomaly (σ T's/ σ t) and the corresponding change in the depth of the ocean mixed layer (h'). However, an alternate proposal by Chu (1991a,b, 1992) holds that there are both positive and negative correlations between σ T's/ σ t and h'. Chu's proposal, based upon the modified Kraus-Turner ocean mixed layer (OML) thermodynamic model, goes further to say that the regions occupied by these positive and negative correlation values correspond roughly to those occupied by positive and negative values of a surface forcing function, P, that is an indication of the strength of the counteracting surface forcings of wind work and buoyant damping. The model-generated fields of surface wind stress, net heat flux, sea surface temperature, and primary (mixed) layer depth are analyzed for a two year ENSO event, 1986 - 87, covering the region of the equatorial Pacific, 10N to 10S and to 140E to 80W, in order to determine the validity of these theories. The results shows a fairly uniform P-field over the entire period, consisting of a negative P-field (indicative of a shallowing regime) in most of the western Pacific and in the far eastern part of the eastern Pacific with a positive P-field (indicative of an entrainment regime) in between. The correlations between σ T's/ σ t and h' show that there exists both positive and negative correlations between σ T's/ σ t and h', however, there is no appreciable similarity between the regions occupied by positive and negative correlations and those occupied by positive and negative P-values.

MASTER OF SCIENCE
IN
PHYSICS

OBSERVATIONS OF BREATHER SOLITONS IN A NONLINEAR VIBRATORY LATTICE

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Master of Science in Physics-March 1992
Advisors: Bruce C. Denardo & Steven L. Garrett-Department of Physics

Experimental, numerical, and analytical investigations of steady state upper cutoff breather solitons in a one-dimensional lattice of coupled nonlinear oscillators are reported. These states are self-localized standing wave structures that can be considered as amplitude modulations of the upper cutoff mode, in which each oscillator is 180° out-of-phase with its immediate neighbors. The observation of the upper cutoff breather follows observations by previous investigators of the three other types of cutoff solitons: lower cutoff breathers, and lower and upper cutoff kinks. The experimental system is a lattice of magnetically coupled pendulums that is oscillated vertically. Numerical simulations are made in a lattice that approximately models that actual lattice. The structures are analytically described by a solution to a nonlinear Schrödinger equation supplemented with zero and second harmonics. The harmonic terms produce an antisymmetry in the breather amplitude profile that is noticeable in the experimental data and can be extreme in the numerical simulations. The theory completely fails in the extreme case, although the breather continues to exist.

THEORY FOR THE CEBAF AND SHIPBOARD FELS

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The development of the free electron laser (FEL) as a source of coherent radiation continues toward the fulfillment of its potential for high power, high efficiency and short wavelength. New experiments toward fulfillment of the FEL's potential present new phenomenon to be studied by theoreticians and experimentalist. Two of these phenomenon in short wavelength FELs are the shift in phase velocity resonance and the reduction in gain. The first part of this thesis presents an argument for the use of the FEL in a maritime military capacity. The advantages of the FEL over conventional kinetic systems and other high-energy laser systems are emphasized. The remainder of this thesis examines several effects of short wavelength FELs. In particular, Chapter IV examines the characteristics of the proposed CEBAF UV FEL and presents alternative designs to assist in design selection. Chapter V analyzes the resonant phase velocity shift and loss in gain that occurs in short wavelength FELs and presents a method to predict the resonant phase velocity and gain. Chapter VI presents a new tool for examining the optical mode within the FEL. By removing the input optical field from the total optical field, only the excited optical field amplitude and phase remain. Chapter VI presents a modification to a self-consistent three-dimensional simulation that will display the excited optical field.

SURVEY OF TRAPPED PLASMAS AT THE EARTH'S MAGNETIC EQUATOR

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Analysis of data from the HPCE experiment on the AMPTE/CCE satellite established probability distributions for trapped ions and electrons. Trapped 150 eV electrons occurred primarily in the dawn to noon local time sector, centered at L = 6. Trapped 50-150 eV ion distributions show strong L versus local time dependence, but are primarily found on the (dusk sector was not sampled for ions in this survey). This local time dependence appears to reflect the L versus local time dependence of the plasmapause. The regions of peak occurrence probability for trapped ions were mutually exclusive with the high probability regions of trapped electrons. This offset in the location of trapped plasma species was seen frequently on a daily basis as well as in the statistical survey.

THEORY FOR THE CEBAF INFRARED AND SHIPBOARD FELS

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The continuing development of the free electron laser (FEL) as a powerful and versatile source of coherent radiation steadily drives toward the goal of high efficiency and broad tunability at shorter wavelengths. New experiments provide significant data and insight for analysis by theoreticians and experimentalists. Two important areas of study are short electron pulse effects, and the dynamics of optical mode distortion by intense electron beam currents. The initial part of this thesis examines one aspect of the projected task of FEL application as a military weapon. The advantages of the FEL over other directed energy sources are detailed, as well as the challenge presented by the effects of the marine atmosphere to high energy laser propagation. The remainder of this thesis examines several effects of long wavelength FELs. Chapter IV examines the proposed parameters of the CEBAF IR FEL, and the analysis leads to predictions describing system performance. Chapter V examines the effects of single pass optical mode distortion for FELs with narrow electron beams. Single-mode theory states that gain is proportional to the product of electron beam current and filling factor, but three dimensional simulations show that gain is a function of electron beam filling factor alone. Also examined is a phenomenon of destructive interference of light in the FEL undulator. Chapter VI extends the analysis of the relationship of gain and beam size to include multiple passes of laser light through the laser resonator. This affirms the general gain relationship, where gain is a function of electron beam filling factor, and also further explores the phenomenon of destructive interference within the optical mode.

RADIATION SURVEYS OF THE NAVAL POSTGRADUATE SCHOOL LINAC

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The NPS LINAC was initially designed for use in radiation damage and nuclear structure studies. The LINAC's role has subsequently evolved to include research in a variety of other areas such as the generation of coherent microwave, optical, and x-radiation. The use of high energy electrons produces a radiation environment for which personnel and equipment safety must be addressed. It is the purpose of this study to measure the radiation levels in the areas surrounding the LINAC and to identify the sources of that radiation. A guide is provided for the installation of additional supplemental shielding for the LINAC to further reduce radiation levels in areas occupied by personnel. Primary conclusions of this study are that the radiation levels produced by the linear accelerator are below statutory limits, and that a neutron energy correction factor different than currently used should be used for personnel dosimetry at the NPS LINAC. This will result in the reduction of the TLD measured neutron dose evaluation for personnel.

MAGNETIC FIELDS GENERATED BY INTERNAL OCEAN SEAWATER MOTION

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This thesis models induced magnetic fields from the motion of seawater in the earth's magnetic field analytically and compares the results to arctic on-the-ice magnetic fluctuation measurements. The oceans have various types of internal motions, such as internal waves and turbulence. This motion of seawater, which is a conductor, in the earth's magnetic field induces a current density. This current density, in turn, induces its own magnetic field. This thesis models internal waves and upper layer ocean turbulence analytically. The corresponding induced magnetic fields are calculated using a static form of Maxwell's equations and parameters for the Arctic are inserted. Comparisons are made with measurements from the Arctic Internal Wave Experiment (1985). The predicted fields from internal waves have magnitudes that are measurable and of the same order of magnitude as ionospherically generated fields. The predicted fields from turbulence are several orders of magnitude smaller than ionospherically generated fields. Besides giving information about internal motions in the ocean, the seawater induced fields are a noise source in magnetic anomaly detection.

EXPERIMENTAL CONSIDERATIONS OF HIGHER ORDER PARAMETRIC X-RAYS FROM SILICON CRYSTALS OF VARYING THICKNESSES

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Generation of parametric x-radiation (PXR) may be described as the Bragg scattering of virtual photons to produce real x-rays which satisfy the Pragg condition $n\lambda = 2d\sin\Theta_B$, where Θ_B is the angle between the electron beam and the crystal plane. Enhanced higher order parametric x-radiation from the <220> and <111> planes silicon crystals of varying thicknesses were observed. Production of PXR of the order n=1 for both planes of a 20 μm thick crystal and of the orders n=1, and n=2 of the <220> and the n=1, n=3, and n=4 of the <111> planes of 44 μm and 320 μm crystal were observed. Exploiting the formation and attenuation lengths of silicon crystals of various thicknesses, higher order x-radiation production is enhanced relative to the lower energy first order x-ray. Photons of 4.5 to 21 keV have been observed.

THEORY FOR A HIGH POWER FREE ELECTRON LASER AND TACTICAL APPLICATIONS

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The free electron laser (FEL) shows potential as a source of coherent, high average power radiation. The achievement of high average power is one of the main topics of current FEL research. This thesis examines the Boeing Average Power Laser Experiment (APLE), whose main goal is to demonstrate the FEL's high average power capability for the first time. The experiment is in the design stage, with completion scheduled for 1996. The first part of this thesis presents a version of a conventional Theater Ballistic Missile Defense (TBMD) system. The advantages of directed energy weapons, specifically the FEL, are also discussed. The remainder of this thesis examines APLE. Chapter V presents research on the oscillator, and Chapter VI deals with the amplifier. Research indicates the current APLE design is feasible and can meet its design goal. Suggestions are presented for optimizing the performance of the oscillator/amplifier system.

COMPARISON OF ALKALI ION EMITTERS

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Lithium, Potassium, and Cesium ion sources have been studied using devices based on thermal emission from a Beta-Eucryptite structure as possible ion sources for use in satellite charge control. The experiments evaluated the power requirements of the different ion emitters to produce approximately 10(μA) of current and tested the effects of using an Osmium-Ruthenium coating to increase the work function of the emitter surface. Lifetime tests of the different ion emitters were also performed. Analysis of the experimental findings showed that Lithium ion sources with a lifetime of 93 hours and Potassium ion sources with a lifetime of 44 hours produced acceptable current levels for use in spacecraft charge control devices. Potassium sources produced the necessary current, 10(μA), at 140°(C) lower temperature than the Lithium sources. All of the coated sources produced wildly fluctuating currents at the 10(μA) level and were not acceptable for the purpose intended.

A THEORY FOR WHISTLER WAVE AMPLIFICATION AND WAVE PARTICLE INTERACTION IN THE MAGNETOSPHERE

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Whistler waves are a type of very low frequency (VLF) radiation which propagate through the earth's magnetosphere. This phenomenon can occur as a result of a lightning discharge and can be produced using ground-based VLF transmitters. It is theorized that these signals travel through ducts centered on geomagnetic field lines. While passing through these ducts the waves are amplified through resonant interaction with electrons in the radiation belts which are following helical paths around magnetic field lines. A description of whistlers and the related topic of VLF emissions is presented in Chapter II, along with a description of how these effects change the properties of the ionosphere. Starting with the Lorentz force equation, the equations of motion for electrons in the magnetosphere are developed in Chapter III. These equations are numerically integrated along with a wave equation developed in Chapter IV. The results of the simulation are presented in Chapter V for the idealized case of a monoenergetic beam of electrons. High and low gains in the wave amplitude are observed for both strong and weak initial VLF fields. The simulation is also run using distributions to represent the initial energies of the electrons in the radiation belts. Chapter VI presents some possible ways to make the simulation more realistic along with a summary of the similarities between the theory presented and Free Electron Laser theory.

INVESTIGATIONS OF A SINGLE POINT TEMPERATURE PROBE FOR MEASUREMENT OF ATMOSPHERIC TURBULENCE

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Gradients in the index of refraction caused by temperature fluctuations create optical turbulence. This optical turbulence greatly degrades the performance of imaging and laser systems operating in the atmosphere. There are several methods of measuring optical turbulence in the atmosphere, but few give a high resolution profile of the turbulence at all levels displaying the "layers" of turbulence that exist. This thesis is an investigation of the use of a high speed temperature probe coupled with a VIZ 9000 meteorological system to measure the optical turbulence in the atmosphere from a ground base to approximately 25 km. The processing of the data is done by a program developed as part of this research. The outputs of the program are r_o, Θ_o, and C_n^2 as functions of altitude.

THE USE OF CHAOS METRICS TO ANALYZE LAGRANGIAN PARTICLE DIFFUSION MODELS

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Chaos metrics are examined as a tool to analyze atmospheric three-dimensional dispersion models at the individual particle rather than the aggregate level. These include the self-affine fractal dimension, D_A, Shannon entropy, S, and Lyapunov exponent, λ. Intercomparison of these metrics is first performed with the one-dimensional logistics difference and the two-dimensional Henon systems of equations. The fractal dimension and Shannon entropy are then measured as a function of the inverse Monin-Obukhov length (1/L) for two three-dimensional Lagrangian particle dispersion models, the McNider particle dispersion model and the NPS particle dispersion model now under development. The fractal dimension and Shannon entropy uncover weaknesses in both models which are not obvious with standard geophysical measures. They also reveal similarities and differences between the atmospheric models and simple chaos systems. Combined, these chaos measures may lend detailed insight into the behavior of Lagrangian Monte Carlo dispersion models in general.

INVESTIGATION OF AN ARGON-FILLED THERMOACOUSTIC PRIME MOVER

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The goal of this thesis is to investigate the behavior of a thermoacoustic prime mover filled with argon. Data was collected for three different operating conditions: 1) prior to the onset of acoustic oscillation, 2) immediately after onset and 3) after the prime mover had reached steady state, at mean gas pressures of approximately 80 kPa, 205 kPa and 305 kPa. Measured values of 1/Q are compared to predictions of a theory based on Swift's work (Swift, G. W., "Thermoacoustic Engines," J. Acoust. Soc. Am. Vol. 84, October 1988). After onset, Q is determined from measurement of the rise time of the oscillations. The data set collected is the first to span onset and results show good agreement with theory. It is concluded that the theory can be used to provide reasonable input for a model to predict the steady state waveforms.

MEASUREMENT OF SURFACE LAYER OPTICAL TURBULENCE ABOVE AMOS

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Temperature fluctuations in the atmosphere severely limit the angular resolution of earth bound observation facilities to around 1 arcsecond. This corresponds to an effective, coherent, aperture size of 10 cm even though the telescope may have a 2-4 m primary mirror. Understanding the spatial and temporal distribution of atmospheric optical turbulence is essential to maximize the performance of large astronomical telescopes. This thesis made use of a 5 kHz high frequency, short range Doppler acoustic sounder to investigate the first 100 meters of the mountain boundary layer turbulence above the Air Force Maui Observation Site, AMOS, Haleakala, Hawaii. These measurements were part of a coordinated site evaluation for a proposed 4 m telescope to be built at AMOS in the near future. Tentative results revealed significant layering, 15-20 m and occasionally thicker, in the turbulent surface layers above AMOS. Additionally, a comparison of two proposed construction sites near the top of Haleakala showed that the turbulent surface layer tends to follow the contours of the mountain.

KINK-ASSISTED MODE HOPPING IN A SURFACE WAVE RESONATOR

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Self-localized kink structures have been observed in standing surface gravity waves in a parametrically driven annular channel of liquid. The kink regions have substantially greater amplitude and smaller wavelength than the extended mode region, and can exist indefinitely only for sufficiently large drive levels such that the structures exhibit violent breaking and jetting motion. For lower drive levels, the structures exist as transients that spontaneously participate in the transition from one mode to a mode with either one less or one more wavelength. In this mode hopping process, the destruction or creation of the wavelength occurs in the kink region. The kink structures are predicted to exist according to a theory that simultaneously allows amplitude and wave number modulations of a finite-amplitude standing wave. This situation is in fundamental contrast to nonlinear Schrödinger solitons, which correspond to only amplitude modulations, and to all other known types of solitons.

DESIGN AND EVALUATION OF ION SOURCE FOR SATELLITE CHARGE CONTROL

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This thesis describes the design of a new spacecraft charge control device that incorporates a solid ion source made of Lithium of Potassium salt impregnated into a porous tungsten plug. The ion source was configured with a reentrant thin-wall heat shield to reduce heat loss and an experimental thermocouple imbedded in the plug to accurately measure emission temperature. The initial design of the charge control device included an extraction grid, deceleration grid, and an electron filament source. Experiments were conducted on the charge control device and results were used to modify the design for optimization of current out of the device versus power used. Incremental testing and subsequent modifications resulted in the deceleration grid being removed and the extraction plate's wire mesh being removed to allow a clear path for the ions. With these changes the requirement of 10 microamps was achieved at 13 watts with the Potassium ion source.

HIGHER ORDER PARAMETRIC X-RAYS

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Parametric x-radiation (PXR) may be described as the Bragg scattering of virtual photons to produce real-x-rays which satisfy the Bragg condition $d\sin_{\theta}=n\ \lambda$, where $_{\theta}$ is the angle between the electron beam direction and a crystal axis. Enhanced higher order parametric x-radiation from {002} plane of a mosaic graphite crystal has been observed. Production of PXR of the order n=2 exceed that from the first order, and x-rays of order up to n=6 are readily seen. The production of higher order x-radiation is obtained by using a thick crystal where the formation and attenuation lengths are exploited to enhance higher energy x-ray formation relative to the lower energy first order x-radiation. Photons of energy 5 to 30 KeV have been measured. The experiment was conducted with a 90 MeV electron beam from the Naval Postgraduate School electron linear accelerator. A three axis target position program, Easy-Mover, was developed to allow for precision orientation of the crystal axis with respect to the electron beam.

DEVELOPMENT AND TESTING OF A PROTOTYPE ELECTRO-OPTICAL PHASE ENCODED POSITION TRANSDUCER

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A proof-of-concept experimental validation of a proposed idea for a prototype electro-optical phase encoded position transducer was conducted. The intensity of two IR LED beams were modulated sinusoidally at frequency ω, with a 90 degree temporal phase difference. They were further modulated by a pair of sinusoidal optical encoding masks with 90 degree spatial phase difference. The mask pair was mounted on a mechanical stage and translated perpendicular to the beam axis. The sum of the two signals produced by this electro-optical configuration constituted another sinusoid at temporal frequency ω, whose phase was proportional to the mask position. Although small deviations from ideal behavior were observed, the validity of the technique has been established incontestably.

INVESTIGATION OF A CCD CAMERA FOR MEASUREMENTS OF OPTICAL ATMOSPHERIC TURBULENCE

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Atmospheric turbulence introduces random phase distortions in optical imaging systems. The development of new laser and imaging systems requires information on the spatial and temporal distribution of this atmospheric turbulence. Measurements of the image spread and the jitter induced by the atmosphere on an optical system provide two techniques to quantify these phenomena. This thesis evaluates a Spectra Sources Lynxx PC Plus charge coupled device (CCD) array as an atmospheric turbulence sensor. Data acquisition and processing programs were written to measure the image spread of a point source and centroid jitter of a point source imaged through the atmosphere. Since atmospheric jitter measurements require high image frame rates on the order of 200 images per second, a large portion of this thesis involved measurements of the times for the CCD detector, interface board and IBM compatible computer to perform their tasks. Recommendations for higher performance are presented.

ON THE CONSEQUENCES OF BI-MAXWELLIAN DISTRIBUTIONS ON PARALLEL ELECTRIC FIELDS

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Observations made by the SCATHA and DE-1 spacecraft reveal the existence of equatorially trapped plasmas. These plasmas may be described by a bi-Maxwellian distribution function. A resultant parallel electric field arises as a consequence of this distribution function. This thesis models the latitudinal density profiles and the resultant parallel electric field that occurs by integrating the particle distributions to obtain the density, and assuming quasi neutrality to solve for the electric potential and hence the electric field. The results show that the density profile is a maximum at the equator and the equatorially trapped plasma is confined closer to the equator for higher anisotropy ratios. The modeled density profiles are in agreement with some observations. The electric fields that result are on the order of 0.1 μV/m pointing away from the magnetic equator with greater anisotropy leading to larger electric field strength. Density minimums have also been observed at the magnetic equator. This minimum can be explained by the presence of a field aligned electron distribution.

INVESTIGATION OF DEEP DIELECTRIC CHARGING AND SUBSEQUENT CURRENTS ON GEOSYNCHRONOUS SPACECRAFT

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Deep dielectric charging is the suspected mechanism for formation of potential barriers aboard the ISEE 1 spacecraft. Energetic electron distribution functions in the plasmasheet were examined for both surface and deep dielectric charging. Surface charging was found to be dependent on whether the satellite surfaces were in shadow. The surface potential is regulated by photoelectric emission, and is two orders of magnitude higher than other mechanisms. Deep dielectric charging deposits charge within dielectrics, and is independent of surface effects, such as photoemission and radiation-induced conductivity. Deposition of electrons into solar array cover cells begins at approximately 10 keV.

PLASMA INTERACTIONS IN A PLASMA EROSION OPENING SWITCH

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Plasma Erosion Opening Switches (PEOS) are important elements in pulsed power equipment. The conduction and opening properties of these switches are highly dependent on the near cathode electric and magnetic fields, and plasma surface interactions. The cathode interaction is highly nonuniform, and micron sized cathode spots form within nanoseconds. The mechanism for the formation of these spots and their contribution to the conduction and opening phases of the switch is not yet well understood. The existing model of explosive electron emission does not adequately explain the performance of the switch during operation. The proposed new model for the near cathode effects accounts for time delays in the onset of conduction in the switch which have been seen experimentally. This is the first experiment in a series to verify this model, and to model a possible mechanism for cessation of conduction.

FOCUSING X-RAY TRANSITION RADIATION WITH CYLINDRICAL AND ELLIPTICAL OPTICS

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We have demonstrated the ability of a nickel elliptical tube to focus the conically diverging pattern of x-ray transition radiation. The x-ray TR was produced by passing moderate-energy (60 to 100 MeV) electron beams through targets consisting of thin (1 μm) multiple foils of aluminum and titanium. The foils were placed in a vacuum chamber; perpendicular to the Naval Postgraduate School's linac primary beamline. An elliptical nickel tube, with a length of 30.5 cm, was placed concentric to the axis of the conical photon beam (as defined by the axis of the electron beam) with an entrance and exit of 1.4 m and 1.7 m, respectively, from the source of the TR at the end of the foil stack. The intensity profile was subsequently measured with a linear image detector placed 3.0 m from the exit of the foil stack. Through a series of experiments, taking into account the effects of surface roughness, the nickel elliptical tube demonstrated the ability to collect 3 to 5 times more energy than a cylindrical quartz tube.

AN ANALYSIS OF MIDDLE ULTRAVIOLET DAYGLOW SPECTRA

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Middle ultraviolet spectra from 1800 to 3400Å are analyzed. These spectra were obtained from the March 1990 rocket flight of the NPS MUSTANG instrument over the altitudes 105km to 315km. The data were compared with computer generated synthetic spectra. A least squares fitting procedure was developed for this purpose. Each data point was weighted using the standard deviation of the means. Synthetic spectra were generated for the following emissions: N_2 Vegard-Kaplan; N_2 Lyman-Birge-Hopfield; NO γ , δ, and ϵ; OI 2972Å; OII 2470Å; and NII 2143Å. Altitude profiles for the emissions were obtained. Tentative identification was made of the OIII 2853Å emission. A comparison of VK and LBH profiles demonstrates the process of N_2 A-state quenching by atomic oxygen.

MAGNETIC FIELD MEASUREMENTS OF THE CEBAF (NIST) WIGGLER USING THE PULSED WIRE METHOD

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The Free Electron Laser (FEL) has proven to be a versatile photon source for many applications in science, industry and defense. It is capable of providing wide tunability and high efficiency, but has yet to yield the high average power required as a weapon system. The proposed infrared and ultraviolet FELs at the Continuous Electron Beam Acceleration Facility (CEBAF) have been projected to provide high average power. The first section of this thesis will study the necessity of a FEL for shipboard defense, and state the advantages over other defense systems. The remainder will focus on use of the pulsed wire method for measuring the magnetic field errors of the CEBAF/National Institute of Science and Technology (NIST) wiggler. Data analysis indicates the wiggler will have a net electron beam deflection of $\Delta x \approx 5.2$ mm, which is much greater than the electron beam radius of $r_e \approx 0.4$ mm and the optical mode waist of $w_o \sim 1$ mm.

CURRENT DENSITY LIMITATIONS IN A FAST-PULSED HIGH-VOLTAGE VACUUM DIODE

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An investigation into the limitations on the enhanced field-emitted current density in a fast-pulsed (rise-time ≈ ns), high voltage (> 10^6V), 1-inch vacuum diode was conducted using a computer simulation based on the Fowler-Nordheim equation. Oscillations in the emitted current density (due to the change in the amount of space charge within the gap) were found to quickly decay into a final steady-state for the voltage applied. Steady-state values for a wide variety of work functions, electric field enhancement factors (based on theory that "whiskers" on the cathode surface experience varying degrees of enhancement), and applied potentials were compared to two benchmarks: the amount of current density required to explode a whisker in < 10 ns by joule heating $J_E = 10^9$ A/cm^2); and the Child-Langmuir (C-L) space-charge-limited current density. Steady-state values were found to be less than J_E. One model of the formation process of a plasma at the cathode surface requires that J_E be met or exceeded by the steady-state value. Thus, such a model is not supported by this project's findings. The C-L limit is based on a thermionic-type emission process. As only pure field emission (i.e., no thermionic emission included) was considered, the steady-state values were, in all conclusive cases, less than the corresponding C-L limited values.

MONTE CARLO ANALYSIS OF ENERGY DEPOSITION IN SOLID STATE MATERIALS BY 400 AND 200 MEV ELECTRONS

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Radiation dose distribution measurements have been carried out by the Naval Surface Warfare Center (NSWC) using 200 and 391 MeV electron beams completely penetrating layers of Aluminum, lead and aluminum, polymethyl methacrylate (PMMA), and PMMA sandwiching an air gap. For the case of 391 MeV electrons, the results have been compared previously to the corresponding distributions predicted by the Monte Carlo simulation codes EGS3 and ACCEPT [Ref. 1]. Those measurements/predictions for 391 MeV are here compared to predictions by the CYLTRAN electron/photon transport code, and the 200 MeV measurements done by NSWC are compared to CYLTRAN calculations. The CYLTRAN code predictions agree well with measurements at 391 MeV. Comparison of CYLTRAN calculations with the NSWC results for 200 MeV indicates possible saturation of the detectors used to take the measurements. The distribution of energy dose within the target has a large dependence on the location of the air gap. The variation in dose distribution is caused by the change in target geometry resulting from insertion of the air gap.

MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

EFFECTS OF SURFACE-BASED DUCTS ON ELECTROMAGNETIC SYSTEMS

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Master of Science in Systems Engineering (Electronic Warfare)-September 1992
Advisor: Kenneth L. Davidson-Department of Meteorology

A study of the effect the atmosphere has on anomalous propagation is performed on an active radar fire control/guidance system operating around 13 GHZ and a passive Electronic Support Measure (ESM) countermeasure (CM) system designed to detect signals in the 600 MHZ range. Atmospheric conditions for three different areas of the world were examined: the Persian Gulf, the Indian Ocean and the Caribbean. Also demonstrated were the different effects horizontally homogeneous and inhomogeneous atmospheric profiles can have on electromagnetic (EM) systems. A comparison with a standard atmosphere was done for both the radar and the ESM system to illustrate the effect ducting conditions have on extended signal strength.

STATIC SCHEDULER FOR HARD REAL-TIME TASKS ON MULTIPROCESSOR SYSTEMS

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Task scheduling is one of the most important issues in a hard real-time system, because it is the schedule that ensures the tasks meet their deadlines and precedence constraints. Given a set of hard real-time tasks, to determine whether a feasible schedule exists such that the timing constraints and precedence constraints of the tasks are satisfied, and to produce such a schedule if one exists are the purposes of a static scheduler. The previous work done for the static scheduler in the computer-aided prototyping system (CAPS) was mainly for the single processor environment. The major work of this thesis is to develop several algorithms for scheduling hard real-time tasks on *multiprocessor systems* so that the associated timing and precedence constraints, as well as the communication requirements are met under the worst-case situation.

EVALUATION OF RADAR PERFORMANCE DEGRADATION DUE TO STANDOFF JAMMING

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Advisor: Gurnam Gill-Department of Electrical and Computer Engineering

This thesis evaluates the performance degradation of Airport Surveillance Radar (ASR-9) due to standoff jamming. ASR-9 data was taken from open literature on this civilian radar. Jammer parameters which are representative of the actual system were postulated to keep the study unclassified. Using these parameters the effect of standoff jamming on detection of targets is evaluated. This evaluation is performed by finding the change in radar SNR due to jamming and computing the probability of detection with and without jamming.

DESIGN AND IMPLEMENTATION OF A GROUP MEMBERSHIP PROTOCOL

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A group membership protocol ensures agreement and consistent commit actions among group members to maintain a sequence of identical group views in spite of continuous changes, either voluntary or otherwise, in processors' membership status. In asynchronous distributed environments, such consistency among group views must be guaranteed using messages over a network which does not bound message delivery times. Assuming a network that only provides a reliable, FIFO channel between any pair of processors, one approach to designing such a protocol is to centralize the responsibility to detect changes, ensure agreement, and commit them consistently in a single manager process. This approach is complicated by the fact that a protocol to elect a new manager with a consistent membership proposal must be executed when the manager itself fails. In this thesis, a membership protocol based on ordering of group members in a logical ring that eliminates the need for such centralized responsibility is presented. Agreement and commit actions are token-based and the protocol ensure that no tokens are lost or duplicated due to changes in membership. It is able to process continuous changes to the membership, does not depend upon any majority-based decisions, and processes joins and departures identically. The cost of committing a change is always $2n$ point-to-point messages over FIFO channels where n is the group size. The protocol correctness is proven in a formal framework. The implementation details for the protocol to execute on a network of SUN workstations are presented. Detailed examples of the behavior of the protocol for various sequences of changes to group membership is presented. The programs for various client-server communication patterns used for interfacing various functions are also presented.

AN/SLQ-32 EW SYSTEM MODEL: AN EXPANDABLE OBJECT-ORIENTED, PROCESS-BASED SIMULATION

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Master of Science in Systems Engineering-September 1992
Advisor: Michael P. Bailey-Department of Operations Research

This thesis documents the design and implementation of a simulation of AN/SLQ-32 Fleet Defense EW System in a modern, object-oriented, process-based simulation language called MODSIM II by CACI Corporation of La Jolla, CA. The main intent of the simulation is to build a model that simulates an AN/SLQ-32 EW system's capability in an environment having an arbitrary number of different emitters. The trials presented in this work use 15 distinct emitters. This simulation model is designed to provide a foundation that not only can be used to study AN/SLQ-32 EW system reliability, but also can be built upon as a part of a wargame or modified to study varied topics such as training effectiveness of naval EW system operators.

AUTOMATED PERFORMANCE EVALUATION TECHNIQUE FOR CRYPTOLOGIC SITES

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Advisor: Donald V.Z. Wadsworth-Department of Electrical Engineering

Currently, Naval Security Group (NSG) personnel lack an automated system for evaluating Signals-of-interest (SOI) collection performance of NSG sites. The performance evaluation technique (PET), developed by the faculty and students of the Naval Postgraduate School, is intended to meet this need. A means for automating the PET has been developed under this thesis research. This "MATLAB Automated PET System" (MAPS) is described in detail in this thesis and compared with the previous manual PET and a semi-automated version based on GRAFTOOL software. MAPS, based on the high-level language, MATLAB, utilizes measured signal and noise levels, and system gains and losses to evaluate site performance in terms of percent of SOI lost. This information is critical to managers and operators of the various NSG collection sites located throughout the world. It permits managers to assess operator performance, evaluate the impact of encroachments in the vicinity of the site, determine the utility of proposed interference mitigation actions, recognize the effect of natural phenomena (such as solar storms) on SOI collection capability, and predict future SOI collection performance. The manual, semi-automated, and automated PET systems were compared in the areas of cost, speed, ease-of operation, and accuracy of the performance estimation. MAPS was determined to be the most useful approach for providing automated PET capabilities to the NSG sites.

DEFINITION OF THE SEA SURFACE INFRARED SUN GLITTER CORRIDOR

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Master of Science in Systems Engineering-September 1992
Advisor: Alfred W. Cooper-Department of Physics

Measurements of sea surface radiance were made in the 2-5.6 and 8-14 μm wavebands within patterns of intense specular highlights formed near the azimuth of the sun at low solar observation angles. From these measurements, an analysis of the statistical and physical nature of a sun glitter channel as presented to a low altitude observer (i.e., shipboard) was conducted. Findings showed strong correlations between wind speed and corridor width, and between wind speed and the strength of source radiance, dominated primarily by the direct solar reflected contribution to sea radiance. 8-14 μm radiances showed far less susceptibility to the detrimental effects of sun glitter on IR sensing systems. All patterns were gaussian in shape across the azimuthal extent of each glitter corridor. The magnitude of glinting radiances decreased with increasing depression angles, presenting an approximate half gaussian radiance distribution in elevation. A method to convert apparent radiance (as received at the sensor) to equivalent zero-range blackbody source radiance was formulated but showed weaknesses in computing the path radiance of the atmosphere intervening between the sea and the AGA 780 sensor, and in accounting for the emissivity of the sea surface as it affected the self-emitted component of sea surface source radiance.

PERFORMANCE EVALUATION OF A RADAR BY COMPUTER

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Master of Science in Systems Engineering-September 1992
Advisor: Gurnam Gill-Department of Electrical and Computer Engineering

This thesis evaluates the radar range performance of Airport surveillance Radar-(ASR-9) in thermal noise, as well as in presence of clutter and jamming. Radar software available from Artech House was used for the performance evaluation. Computation of detection range in this software is based on empirical calculation of detectability factor in contrast to Marcum-Swerling method which is based on standard radar detection theory. ASR-9 was chosen because it has no military significance and data on it is easily available.

DISTRIBUTED PROCESSING ON LINK ENHANCEMENT

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Master of Science in Systems Engineering-September 1992
Advisor: Chyan Yang-Department of Electrical and Computer Engineering

Link enhancement is a classical optimization problem where a military network manager wishes to enhance his network's survivability and routability with a given budget and faces with a multitude of potential architectural configurations from which to choose. This problem is NP-complete and good heuristics do exist. However, heuristics are still computational intensive. Distributed processing of the problem uses multiple workstations to cooperatively solve the problem such that the network manager can make his decision faster than running the algorithms on a single computer. This thesis reports the experiences of using distributed computation and its benefit.

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY

CONCEPTS AND ISSUES FOR SYSTEMS INTEGRATION OF U.S. AIR FORCE DEPLOYABLE COMMUNICATIONS

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Master of Science in Systems Technology-June 1992
Advisors: Dan C. Boger & Carl R. Jones-Department of Administrative Sciences

This thesis examines the broad issues and concepts which impact the effectiveness of U.S. Air Force deployable communications. A high-level "systems analysis" approach was used in this study to gain visibility on the number of elements involved in deployable communications and their interrelationships. Previous studies were reviewed to determine where trends existed, and contemporary analysis efforts were examined for clarity and cohesiveness. The principles of command and control are discussed, followed by a description of the current family of U.S. Air Force deployable communications equipment and how it supports the warfighters in the deployed environment. Central issues and concepts are developed through trade-off analysis and illustrative examples. Key concepts include: time phased arrival of equipment in theater, modularity of design, strategic/tactical interface, and interoperability. Conclusions indicate that persistent systems integration problems are more the result of organizational and conceptual problems than with the physical technologies. Recommendations include the establishment of a "center of excellence" to coordinate and facilitate systems integration. The tools for such a center include clear policy direction, computer models and simulations, trade-off analysis, and artificial intelligence/expert systems. A conceptual architecture is provided to illustrate the desired relationship between cooperative sub-architectures, and a definition proposed for architectures in an attempt to standardize its interpretation.

A HYPERTEXT BASED COMPUTER ARCHITECTURE FOR THE JOINT COMMAND, CONTROL AND COMMUNICATIONS CURRICULUM

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Dan C. Boger-Department of Administrative Sciences

The objective of this thesis is to develop a computer based architecture for curriculum management of the Command, Control and Communications (C^3) curriculum. The architecture is represented using hypertext technology. Knowledge elements are defined for Educational Skill Requirements (ESRs) and core courses, and they are used as key components in the architecture. A general assignment model, that uses knowledge elements, has been included as an aid in curriculum management. The feasibility of implementing the proposed architecture is also discussed. Seven appendices have been included which contain lists of knowledge elements, core courses, a course matrix. Educational Skill Requirements and a discussion of hypertext and multimedia. The software product the author produced using hypertext technology, which is the first implementation of the architecture described in this thesis, can be obtained from the C^3 curricular Office.

INTRODUCTION TO HUMAN FACTORS AND WIDE AREA NETWORKING

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Master of Science in Systems Technology-March 1992
Advisors: Eric S. Theise & Gary K. Poock-Department of Operations Research

The Human-Systems Interaction Course taught at the Naval Postgraduate School is an introduction to the human-systems interface, that part of the system which the human uses to provide input to and receive feedback from the system. This thesis will provide a basic introduction to those factors which must be considered when designing today's complex military systems. Additionally, this thesis will provide an introduction to the Internet - a worldwide network of computers and smaller networks. Students will use the Internet to gather information, access remote programs, and communicate with other personnel around the world. This thesis is only an introduction to both of these complex topics; further research is possible into any of the topics discussed. Appendix A provides a number of basic exercises intended to introduce the concepts discussed in the body of the thesis.

SYSTEMATIC ANALYSIS OF COMPLEX DYNAMIC SYSTEMS: THE CASE OF THE USS *VINCENNES*

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Master of Science in Systems Technology-June 1992
Advisor: Nancy C. Roberts-Department of Administrative Sciences

Recent studies on the *Vincennes* incident have centered around the impact of stress in decision making. This thesis, which is a case analysis of a historical event, offers another perspective through the use of organizational and contextual factors as a means to ascertain "what happened" when the USS *Vincennes* shot down Iran Air Flight 655. Data extracted from the unclassified investigation report by Rear Admiral William M. Fogarty and the transcripts from the Senate Hearing before the Committee on Armed Services were analyzed quantitatively, through regression and correlation analysis in conjunction with a graphical analysis and interpretation, in an effort to resolve the lack of reconciliation between system and recollected data by witnesses. A comparative analysis was also conducted between these archival sources of data and interview data from Captain Will Rogers, III, former Commanding Officer of the *Vincennes*. Additionally, to identify "causal factors" that led to the outcome, further analysis using the Events Path Model, Dynamics Systems Model, and Cybernetic Model of Mutual Causality was conducted. The findings of the quantitative analysis portion supports Captain Rogers' argument, which included a track number issue and the existence of another aircraft. Among the "causal factors" identified contributing to the accidental shoot down, the most significant finding revealed was the failure to identify and differentiate between two aircraft, which was primarily due to the functional lack of negative feedback as a control mechanism that keeps a system stable and under control. Consequently, the issue of stress was not as significant as was originally diagnosed.

TECHNOLOGICAL ENHANCEMENTS FOR PERSONAL COMPUTERS

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Master of Science in Systems Technology-March 1992
Advisor: Gary K. Poock-Department of Operations Research

This research is concerned with the usability and compatibility of many of the aftermarket enhancements commercially available to agencies using microcomputers in their workplace. These devices include biometric access devices, data input devices, storage devices, and data transfer equipment. A limited number of associated software packages will be evaluated along with the hardware involved. This study explores the feasibility of add-on equipment for the Desktop III PC, the Unisys Government contract. Due to delays in availability of a Unisys machine most of the research was done on a 80286 based Packard Bell PB6800 running the MS-DOS 3.3 operating system. Most of the applications were later installed on a Desktop III machine. Security considerations for physical area, data access, and transmission media are discussed as this topic should be a vital concern for DoD computer users. The report concludes with a limited number of application scenarios that represent some of what can be accomplished with personal computers.

USN/USMC ANTIAIR WARFARE AND COMMAND, CONTROL, AND COMMUNICATIONS FOR AMPHIBIOUS OPERATIONS

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B.S., Purdue University, 1985
Master of Science in Systems Technology-March 1992
and
Edward A. Yeaste-Lieutenant, United States Navy
B.E., State University of New York Maritime College, 1984
Master of Science in Systems Technology-March 1992
Advisor: William J. Walsh-Department of Operations Research

There is currently no single document that aids a Joint Task Force Commander or their staff in understanding the complexities of Antiair Warfare (AAW) during amphibious operations by maritime forces. Historically, the Navy has been concerned with the Outer Air Battle. This involves vast distances over the ocean, but does not cover amphibious operations. With the down sizing of the U.S. military as a result of an end to the "Cold War", there will be fewer overseas bases and assets to conduct contingency amphibious operations. The authors review the current and future concepts and doctrine, Command, Control, and Communications, and weapon systems of the U.S. Navy and Marine Corps for AAW during amphibious operations. The authors propose that the Amphibious Defense Zone Coordinator (ADZC) paradigm be accepted so that an integrated air defense of the Amphibious Objective Area (AOA) and the Carrier Battle Group (CVBG) are treated as subsets of the same overall AAW plan.

THE EFFECTS OF TEAM LEADER FEEDBACK ON SITUATION ASSESSMENT IN DISTRIBUTED ANTI-AIR WARFARE TEAMS

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Master of Science in Systems Technology-March 1992
Advisor: Michael G. Sovereign-Department of Operations Research

Situation assessment is the first step in the Command and Control process. In naval tactical teams, it has become more critical even as it has become more difficult. Part of the Navy's attempt to address this issue is the Tactical Decision Making Under Stress (TADMUS) program. Under TADMUS, the Situation Assessment in Naval Teams (SAINT) experiment was run at NPS in December, 1991. This thesis describes the SAINT experiment and uses data collected during the experiment to study the effects of team leader feedback on situation assessment in distributed air defense teams. The emphasis of study is on performance, (error rate and pattern), subjective workload, and communication rates. Findings include: feedback of the leader's current assessment lowers explicit coordination; feedback does not affect subjective workload; feedback increases error rates, and may affect error patterns. Evidence of feedback causing confirmatory bias was also found, but more research in this area is recommended.

AN INVESTIGATION OF THE PHYSICAL CHARACTERISTICS OF A MASS ELEMENT RESONATOR

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Advisor: Thomas J. Hofler-Department of Physics

This thesis investigates the characteristics of an acoustic resonator with a passive mass element. The mass element is substituted as an impedence matched replacement for a section of gas-filled half wavelength resonator tube. The mass element consists of a disk bonded to a Servometer electroformed single convolution nickel bellows. The bellows can be modelled as a circular plate with a spring supported boundary placed in the acoustic center of a resonator between two equivalent gas springs driven by a loudspeaker. Loading changes were used to characterize the bellows' motional response to different drive conditions for the frequency range near the first resonance of the system. The response of the system was highly nonlinear for nearly all the configurations despite minimal loudspeaker drive levels. The nonlinear response was a consequence of the coincidence of the resonant frequencies for several modes of the bellows, particularly two prominent modes - an expected piston-like mode, and an unexpected rocking mode. Attempts were made with varying success to achieve high amplitudes for the piston mode, which is important for its use in a new generation Thermoacoustic Refrigerator. The new refrigerator design will utilize the mass element to reduce those acoustic losses that are a parasitic heat load on the cold end of the refrigerator, as well as make the resonator more compact.

TACTICAL LOCAL AREA NETWORKS

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Advisor Carl R. Jones-C³ Academic Group

During Operation Desert Storm, the senior U.S. Marine Headquarters used a Local Area Network for command and control. Despite some limitations, the network was largely a success. The opportunities for employing the network to a greater extent for command and control are extensive. This requires careful examination of the functions of command and control and the capabilities of the system. Matching functional requirements to system capabilities will lead to optimum employment. Development of doctrine to use the network, education on how to use it, and improvements in its capability are all necessary. This technology is but one example of the available information technologies that must be harnessed for Marine Corps command and control to provide effective support to combat forces. A mechanism must be established for the Marine Corps to focus the efforts of experienced Marine leaders, information technology developers, and Fleet Marine Force system users to forge the vital link between our combat systems - command and control.

REUSABLE ADA SOFTWARE FOR COMMAND AND CONTROL MAP MANIPULATION

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Current DoD Command Control (C^2) priorities call for modular and interoperable C^2 systems that can be assembled easily from standard components to provide unique C^2 capabilities. Since one of the most costly and critical components of a C^2 system is its software, it makes sense to create reusable software components that can be used in this modular building process. This thesis describes a reusable set of Ada software packages and a portable user interface that implements common two dimensional map and symbol manipulation functions in a C^2 workstation environment. This software provides students and researchers a graphical software environment within which different map-based C^2 system concepts such as situation monitoring and decision support can be developed and evaluated.

C^3 INTEROPERABILITY ISSUES: AN OVERVIEW OF GOSIP NETWORK CONFORMANCE TESTING IN THE EVOLUTION OF THE DEFENSE INFORMATION SYSTEM NETWORK (DISN)

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Advisors: Y. S. Fu-Command, Control, and Communications Academic Group &
Myung Suh-Department of Administrative Sciences

This thesis analyzes some of the evolving commercial-off-the shelf (COTS) technologies and potential difficulties in implementing the proposed Defense Information System Network (DISN) based on Government Open Systems Interconnection Profile (GOSIP) compliance and Integrated Services Digital Network (ISDN) conformance testing. It starts by examining the MILDEPs Command, Control, and Communication (C^3) network architectures by providing brief descriptions of the various standards. Not only does it examine such technologies as Fiber Distributed Data Interface (FDDI), Synchronous Optical Network (SONET), Fast Packet Switching (FPS), and Broadband ISDN, but it also highlights some of the ISDN conformance test suites with a view toward migrating these architectures and technologies to the DISN. Results indicate that incompatibilities between C^3 networks will be impacted more in the DISN near-term and transition phases than in the far-term. This is due in part to embedded proprietary functions permeating COTS products and the lack of fully developed ISDN conformance test specifications. The lack of clearly defined standards is a major cause of proprietary implementation. Coupled with the limited availability of ISDN conformance test suites to test multi-vendored MILDEP C^3 networks, this will make deployment of the DISN a challenge. Recommendations for further research are also presented.

MODELING C3: THE EFFECTS OF INFORMATION DELAY IN TACTICAL TIC-TAC-TOE (T4)

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Master of Science in Systems Technology-June 1992
Advisor: Michael Sovereign-Department of Operations Research

The purpose of this thesis is to design, conduct, and analyze a C3 conflict simulation that examines the effect of information delay omission effectiveness. In the experiment the outcomes of student play and computer play of the Tactical Tic-Tac-Toe (T4) simulation are analyzed to determine whether the delay of certain types of information affect mission performance; and, whether computer play results are similar to student play of the same scenarios. Analysis of the experimental data provides strong evidence that in both automated and student play, delay in information about the direct opponent adversely affects mission effectiveness. The comparison between student play and automated play is not quite as clear. For the control teams, which do not experience information delay, automated play very closely resembles student play. But, in the case of the treatment teams, which are subjected to information delay, the evidence is not strong enough to make definitive conclusions.

WARGAMING IN SUPPORT OF COMMAND, CONTROL AND COMMUNICATIONS EXPERIMENTS

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Master of Science in Systems Technology-March 1992
Advisor: William J. Walsh-Department of Operations Research

The purpose of this thesis is to provide information about wargaming to prospective users. An in-depth discussion focusing on two primary components of wargaming is presented. The first component is wargaming in general. A description is provided of wargaming features and a discussion concerning the limitations and hazards inherent to wargames. The second component is how to design a wargame experiment to support command, control and communications (C3) hypotheses testing. A description of the steps in planning a general wargame experiment including a detailed information on wargame software considerations is presented. Finally a synopsis followed by a critique of an actual C3 wargame experiment is provided as an example of the principles given in this thesis.

ASSESSING THE U.S. ARMY'S COMBAT VEHICLE COMMAND AND CONTROL SYSTEM AT THE BATTALION LEVEL

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The United States Army is presently conducting evaluations of the Combat Vehicle Command and Control (CVC2) system. The CVC2 is being developed to assist battalion level commanders and below with their command and control functions. Current evaluations of the system have been focused at the platoon and company levels. This thesis proposes that the greatest benefit of the automated system will be to support battalion level command and control functions. This paper provides; a description of the CVC2 system and the functions it can perform, a description of the process and system used by combat battalions to execute C2, identification of the information requirements of a commander, proposed measures of performance (MOPs) measures of effectiveness (MOEs) and measures of force effectiveness (MOFEs) to be used to evaluate the CVC2 system at battalion level. An evaluation methodology is proposed and areas of concern relating to the implementation of the system are discussed.

USN/USMC ANTIAIR WARFARE AND COMMAND, CONTROL, AND COMMUNICATIONS FOR AMPHIBIOUS OPERATIONS

Edward A. Yeaste-Lieutenant, United States Navy
B.E., State University of New York Maritime College, 1984
Master of Science in Systems Technology-March 1992
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Gilbert C. Gonzalez-Captain, United States Marine Corps
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Master of Science in Systems Technology-March 1992
Advisor: William J. Walsh-Department of Operations Research

There is currently no single document that aids a Joint Task Force Commander or their staff in understanding the complexities of Antiair Warfare (AAW) during amphibious operations by maritime forces. Historically, the Navy has been concerned with the Outer Air Battle. This involves vast distances over the ocean, but does not cover amphibious operations. With the down sizing of the U.S. military as a result of an end to the "Cold War", there will be fewer overseas bases and assets to conduct contingency amphibious operations. The authors review the current and future concepts and doctrine, Command, Control, and Communications, and weapon systems of the U.S. Navy and Marine Corps for AAW during amphibious operations. The authors propose that the Amphibious Defense Zone Coordinator (ADZC) paradigm be accepted so that an integrated air defense of the Amphibious Objective Area (AOA) and the Carrier Battle Group (CVBG) are treated as subsets of the same overall AAW plan.

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(COMMAND, CONTROL, AND COMMUNICATIONS)

COMPARISON OF ELECTROMAGNETIC PROPAGATION PREDICTIONS FROM IREPS AND RPO ACROSS A COASTAL TRANSITION

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Master of Science in Systems Technology (C^3)-March 1992
Advisor: John W. Glendening-Department of Meteorology

The Navy's existing electromagnetic propagation prediction software, the Integrated Refractive Effects Prediction System (IREPS), neglects signal leakage from a duct, approximates diffraction, and assumes atmospheric horizontal homogeneity. To ameliorate these deficiencies, the Radio Physics Optics (RPO) program is being developed. This thesis analyzes the significantly different propagation predictions of the two models. RPO predicts significantly shorter propagation ranges in a duct than does IREPS. RPO predicts variations in duct thickness and height which IREPS idealizes, and RPO also computes a signal strength above the duct. Only RPO predicts significant interactions between the duct's dM/dz gradient and frequency. RPO is capable of modeling propagation paths for an inhomogeneous atmosphere. Neglecting atmospheric inhomogeneities in a coastal region introduces significant propagation prediction errors.

A METHODOLOGY FOR ASSESSING ACQUISITION TECHNICAL RISK

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B.A., Columbia University, 1978
Master of Science in Systems Technology (C^3)-June 1992
Advisor: Michael G. Sovereign-Department of Operations Research

This thesis examines the problems affecting the quantitative assessment of technical risk in Department of Defense major weapon systems acquisition. A Decision Theory approach is used. Commercial techniques and current DoD methods of technical risk assessment are investigated. TASCFORM™ technology values are used in a linear regression model to characterize the growth of technology over time. The model residuals provide a probability distribution for estimating the likelihood of achieving a specified level of technical performance. The benefit of a utility function for describing technical risk perceptions is considered. The Expanded Pearson-Tukey method of describing risk is also investigated. Continued research into technology valuation techniques is recommended. A test case application of the Expanded Pearson-Tukey method is also recommended, to determine its ability to provide reliable and timely quantitative technical risk information.

THE SOVIET COUP: A COMMAND, CONTROL, AND COMMUNICATIONS ANALYSIS

Joseph Howard Herbert-Lieutenant, United States Navy
B.S., Duke University, 1983
Master of Science in Systems Technology (C^3)-March 1992
Advisor: R. Mitchell Brown, III-Department of National Security Affairs

This thesis presents an analysis of the August 1991 Soviet coup from a command, control, and communications (C3) perspective. Through the use of C3 modeling and functional decomposition, the C3 perspective. Through the use of C3 modeling and functional decomposition, the C3 systems developed by the State Committee for the State of the Emergency (SCSE) and the reformist opposition to the coup are examined and the most significant strengths and weaknesses are identified. The comparative model developed for the study, the Coup Operations Process Model (COPM), is an extrapolation of C3 military operations process models. The COPM incorporates the C3 characteristics of crisis management and introduces the concept of a controllable interface separating the immediate and extended operational environments. Specific political, military, and media events preceding the coup are examined to determine critical developmental factors which influenced the structure and operational dynamics of C3 systems employed at the start of the coup. Analysis of the development and execution of the coup substantiates the importance of C3 in the conduct of crisis operations and identifies the key C3 functions which directly affected the outcome of the coup.

SELECTING A SUBSET OF STIMULUS-RESPONSE PAIRS WITH MAXIMAL TRANSMITTED INFORMATION

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B.S., Wright State University, 1986
Master of Science in Systems Technology (C^3)-March 1992
Advisor: Eric S. Theise-Department of Operations Research

System designers are often faced with the task of assigning symbolic representations to user actions, e.g., icons to choices in graphical interfaces. When a *confusion matrix* - on discriminability of the symbols - is available, it is used to guide the selection of the set of symbols to be implemented. While trial and error methods or clustering approaches have been used to analyze this problem, it was only recently that a true optimization approach was offered. Theise (1989) formulated the symbol selection problem as a zero-one integer programming problem whose objective function was linked to the minimization of within-subset confusion. Confusion is not the traditional metric used by human factors engineers to analyze confusion matrices. Rather, *transmitted-information* - a metric from information theory - has long been used to evaluate system performance. The purpose of this thesis is to formulate a model of subset selection in which transmitted information will be maximized. It is possible to specify a correct model, although current algorithms are incapable of solving it. This thesis reports on the performance of a GAMS-based approximation to the original model, as well as an exhaustive enumeration scheme. Solutions from both information-theoretic approaches are compared to solutions from the confusion/recognition model.

COMPARISON OF ELECTROMAGNETIC PROPAGATION PREDICTIONS FROM IREPS AND RPO ACROSS A COASTAL TRANSITION

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Master of Science in Systems Technology (C^3)-March 1992
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The Navy's existing electromagnetic propagation prediction software, the Integrated Refractive Effects Prediction System (IREPS), neglects signal leakage from a duct, approximates diffraction, and assumes atmospheric horizontal homogeneity. To ameliorate these deficiencies, the Radio Physics Optics (RPO) program is being developed. This thesis analyzes the significantly different propagation predictions of the two models. RPO predicts significantly shorter propagation ranges in a duct than does IREPS. RPO predicts variations ct thickness and height which IREPS idealizes, and RPO also computes a signal strength above the duc y RPO predicts significant interactions between the duct's dM/dz gradient and frequency. RPO is cap of modeling propagation paths for an inhomogeneous atmosphere. Neglecting atmospheric inhomogeneities in a coastal region introduces significant propagation prediction errors.

AN ASSESSMENT OF ACCESSIBILITY TO STU-III BY USERS WITH DISABILITIES

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Master of Science in Systems Technology (C^3)-March 1992
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The Secure Telephone Unit - Third Generation (STU-III) was designed for military personnel and other people without disabilities. However DoD personnel and contractors who need to communicate classified or sensitive information also include individuals with a variety of disabilities. STU-III users with disabilities must also be given reasonable access to secure communications. The study evaluated how accessible the current STU-III system is for users with disabilities. Accommodations were proposed to overcome identified barriers. The addition of a Telephone Signaler and computer were proposed to allow users who are deaf to sense when the STU-III rang and to communicate in secure mode. Supplementing the amplifier built into the STU-III with an external amplifier could assist people with a moderate hearing loss. The addition of Locator Dots and modifying the procedure to make a secure call were proposed as accommodations for people with a visual impairment. The use of a speakerphone STU-III or handset holder were accommodations proposed for people with motor impairments. People with hearing or visual impairments evaluated accommodations proposed for them. The study also recommends further modifications to STU-III that may reduce or overcome some of the identified barriers.

COMMAND AND CONTROL ARCHITECTURE FOR MULTI-NATIONAL OPERATIONS

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Master of Science in Systems Technology (C^3)-March 1992
Advisor: Carl Jones-Department of Administrative Sciences

This thesis focuses on the baseline functions that have to be executed in order to coordinate multi-national forces. This thesis is descriptive in nature, describing a multi-national architecture that is one level removed from physical hardware. The author combines the Copernicus Architecture ideology with the Cooperative Engagement structure to develop a baseline architecture (template) that can be used as a checklist for individual unit coordination at the on-scene crisis level. This then allows the tactical unit the ability to coordinate with impromptu allies, without high level state participation to ensure coordination. The author concludes that the baseline functions required by multi-national forces can be coordinated by a tactical on-scene commander, and that high level coordination is not necessary.

FEASIBILITY OF METEOR BURST BUOY RELAY AS A COMMAND AND CONTROL ASSET

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Master of Science in Systems Technology (C^3)-March 1992
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Dan. C. Boger-Department of Administrative Sciences

Meteor burst communication is currently being researched as a survivable, backup means to long-range communications due to a perceived vulnerability to HF and satellite communications. A specific hypothetical link that is analyzed in this thesis is that of a meteor burst relay buoy network. The network consists of fixed land facilities, permanently moored ocean buoys, and air-deployable buoys, all in support of deployed submarines. The advantage of such a system for the submarine fleet is that it would allow the ability of establishing communications whole maintaining a covert posture on-station. This is due to the meteor burst phenomenon of scattering, where a meteor trail projects a small ground illumination footprint, as compared to HF communications. As a result, a meteor burst channel has inherent characteristics that are resistant to ground-based interception and jamming.

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(SPACE SYSTEMS OPERATIONS)

APPLICATIONS OF THE PETITE AMATEUR NAVY SATELLITE (PANSAT)

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Master of Science in Systems Technology (Space Systems Operations)-September 1992
Advisor: Randy L. Wight-Space Systems Academic Group

This thesis provides an analysis of potential Petite Amateur Navy Satellite (PANSAT) system users. At a point in time where large satellite designers are just now beginning to focus their efforts towards capturing a portion of the rapidly expanding light satellite (lightsat) market, the Naval Postgraduate School is designing a lightsat unlike any which has been built before or will be built in the foreseeable future. A single PANSAT (or an entire constellation) can be lofted into orbit at a relatively low cost as a secondary payload on a variety of launch vehicles. Its design makes it an ideal system for providing store and forward communications to a large number of users at a fraction of the cost of most (if not all other) satellite systems. The long-term success of this program relies not only on the technical aspects of design and production but also on the Naval Postgraduate School's ability to create a satellite system that provides maximum utility to potential user communities yet to be explicitly defined.

MEASURING NAVSPASUR SENSOR PERFORMANCE USING LOGISTIC REGRESSION MODELS

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Since its establishment the Naval Space Surveillance Command (NAVSPASUR) in Dalhgren, Virginia has been providing surveillance data (NAVSPASUR data sets) for thousands of space objects in near earth orbit. To date, very little statistical analysis of these data sets in the form of a system performance evaluation has been conducted. The objective of this thesis is to provide NAVSPASUR with a statistical method to evaluate the system performance in terms of its capability of detecting space objects. In this thesis six individual station models, as well as a system-wide model are estimated. Optimal probability levels for classifying predictions are additionally provided. The results being provided are obtained through the implementation of Logistic Regression analysis. The system-wide model estimated in this thesis, is superior in its prediction accuracy when compared to the previous model provided to NAVSPASUR in a September 1991, Naval Postgraduate School Master's Thesis. Finally an implementation program written in the FORTRAN is given. This program provides a user friendly interface capability for predicting system performance in terms of its detection ability.

MASTER OF SCIENCE
IN
TELECOMMUNICATIONS
SYSTEMS MANAGEMENT

THE DEVELOPMENT OF AN INFORMATION SYSTEM MASTER PLAN FOR THE PACIFIC MISSILE RANGE FACILITY, BARKING SANDS, HAWAII

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Master of Science in Telecommunications Systems Management-March 1992
and
Paul D. Bennett-Captain, United States Marine Corps
B.A., Texas A&M University, 1980
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan C. Boger-Department of Administrative Sciences

This thesis provides a general description of the communication facilities and systems currently used by the Pacific Missile Range Facility (PMRF). The system interface requirements to support current range operations are identified and a description of current communications system shortfalls is provided along with recommendations for short-term improvements. A vision of the future is also provided. It suggests that PMRF must adopt a coordinated, integrated, and centralized approach to range communications. Current and future communications system technologies such as digital communications, applicability of different transmission media, and application of the Integrated Services Digital Network (ISDN) are mentioned as avenues for implementing a fully integrated data, voice, and video real-time information network that will support future PMRF range users' service requirements.

STATISTICAL PROCESS CONTROL TECHNIQUES FOR THE TELECOMMUNICATIONS SYSTEM MANAGER

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Master of Science in Telecommunications Systems Management-March 1992
and
Lee W. Schonenberg-Lieutenant, United States Navy
B.S., United States Naval Academy, 1983
Master of Science in Telecommunications Systems Management-March 1992
Advisors: Dan C. Boger & Sterling D. Sessions-Department of Administrative Sciences

The purpose of this thesis is to provide personnel, who are undergoing Total Quality Leadership (TQL) implementation at their telecommunications-related commands, an understanding of Statistical Process Controls (SPCs) and their potential application to telecommunication issues. Basic SPC tools common to all total quality programs are discussed. Advanced SPC methods including Analyses of Means (ANOM), Analysis of Variance (ANOVA), Weibull analysis and Taguchi methods are also presented. Selected SPC training programs of both the U.S. Navy and the commercial telecommunication industry are examined. A case study of a telecommunication-related issue is provided to demonstrate an integrated approach to the use of SPCs.

THE DEVELOPMENT OF AN INFORMATION SYSTEM MASTER PLAN FOR THE PACIFIC MISSILE RANGE FACILITY, BARKING SANDS, HAWAII

Paul D. Bennett-Captain, United States Marine Corps
B.A., Texas A&M University, 1980
Master of Science in Telecommunications Systems Management-March 1992
and
Rolando A. Apollo-Lieutenant, United States Navy
B.S., University of New Mexico, 1984
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan C. Boger-Department of Administrative Sciences

This thesis provides a general description of the communication facilities and systems currently used by the Pacific Missile Range Facility (PMRF). The system interface requirements to support current range operations are identified and a description of current communications system shortfalls is provided along with recommendations for short-term improvements. A vision of the future is also provided. It suggests that PMRF must adopt a coordinated, integrated, and centralized approach to range communications. Current and future communications system technologies such as digital communications, applicability of different transmission media, and application of the Integrated Services Digital Network (ISDN) are mentioned as avenues for implementing a fully integrated data, voice, and video real-time information network that will support future PMRF range users' service requirements.

BASE INFORMATION TRANSFER SYSTEM (BITS)

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Master of Science in Telecommunications Systems Management-March 1992
and
Jan Fitzsimmons-Lieutenant Commander, United States Navy
B.A., University of North Carolina, Chapel Hill
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Eric S. Theise-Department of Operations Research

The purpose of this thesis is to provide base Commanding Officers and communications managers with a non-technical overview of the Base Information Transfer System (BITS). This thesis will discuss the history, current status and implementation of BITS, a subarchitecture of a broad Navy program created to support Department of the Navy communications ashore. The intent is to consolidate various sources regarding BITS into one document and to provide information to aid in understanding how BITS relates to base communications. The study will define the scope of BITS and will examine its relationship to such global communications architectures as Copernicus. This thesis will also explore how BITS implementation will interface with other Navy, military, and worldwide communications systems. Separate chapters discuss how BITS implementation will influence acquisition, economics and equipment technology. This thesis will also describe the functional transfer of Activities Providing Telephone Service (APTS) as an example of one level of the overall BITS subarchitecture. Finally, the authors' conclusions are presented, and areas of possible concern are identified.

MULTIMEDIA ELECTRONIC MAIL: STANDARDS AND PERFORMANCE SIMULATION

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Master of Science in Telecommunications Systems Management-March 1992
Advisor: Myung W. Suh-Department of Administrative Sciences

This thesis surveys the current multimedia electronic mail (e-mail) related standards. The increasing demands for interoperability pushed the international standardization organizations to develop standards for e-mail. The multimedia e-mail related standards include X.400 and ODA. ODA supports formatted text, raster graphics, and geometric graphics. The future standards will be able to support high bandwidth uses such as high-resolution color still-image, full-motion video, voice, and audio. The future components of multimedia e-mail include TIFF for raster graphics, CGM for geometric graphics, JPEG for high resolution color still-image, and MPEG for full-motion video. These multimedia data require vast amounts of storage, processing time, and transmission bandwidth. The standardization efforts can be viewed as selecting the best combination of these three factors, interoperability, and timing consideration. According to this view, the standard for each component is reviewed with frame of background, coding, compression, and current status. With the information from the survey study, a simulation study is conducted to investigate the performance of LAN where multimedia data are transmitted. The simulation results show that the high resolution image browsing activity in a LAN will burden the low speed LANs. The adoption of compression chips or high speed LANs such as FDDI will make such high bandwidth activities feasible.

AN OVERVIEW OF THE COPERNICUS C4I ARCHITECTURE

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Master of Science in Telecommunications Systems Management-March 1992
and
Robert Cruz Morales-Lieutenant, United States Navy
B.S., Mapua Institute of Technology, 1982
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan Boger-Department of Administrative Sciences

The purpose of this thesis is to provide the reader with an overview of the U.S. Navy's Copernicus C^{4}I Architecture. The acronym "C^{4}I" emphasizes the intimate relationship between command, control, computers, communications, and intelligence, as well as their significance to the modern day warrior. Never in the history of the U.S. Navy has the importance of an extremely flexible C^{4}I architecture been made more apparent than in the last decade. Included are discussions of the Copernicus concept, its command and control doctrine, its architectural goals and components, and Copernicus-related programs. Also included is a discussion on joint service efforts and the initiatives being conducted by the U.S. Marine Corps, the U.S. Air Force, and the U.S. Army. Finally, a discussion of the Copernicus Phase I Requirements Definition Document's compliance with the acquisition process as required by DoD Instruction 5000.2 is presented.

NATIONAL AIRSPACE DATA INTERCHANGE NETWORK ANALYSIS

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Master of Science in Telecommunications Systems Management-March 1992
Advisors: Bill Gates & Dan C. Boger-Department of Administrative Sciences

This thesis is a description and analysis of the Federal Aviation Administration's National Airspace Data Interchange Network (NADIN). The objective is to define, for telecommunication students, this data interchange network and examine the effect which current network upgrades will have on network performance. Descriptions of the current Data Interchange Network (NADIN IA) and the next generation Data Interchange Network (NADIN II) are included as well as information on related FAA programs, most notably the Radio Communications Link (RCL). Analysis is presented of NADIN II's impact on the Federal Aviation Administration's Data Interchange capabilities. Implementation problems with NADIN II are addressed. Conclusions include the economic soundness of NADIN II due to leased line savings and a strong recommendation to the NADIN II program manager to aggressively pursue full project funding.

BASE INFORMATION TRANSFER SYSTEM (BITS)

Jan Fitzsimmons-Lieutenant Commander, United States Navy
B.A., University of North Carolina, Chapel Hill
Master of Science in Telecommunications Systems Management-March 1992
and
Donna Doran Cannon-Lieutenant, United States Navy
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Master of Science in Telecommunications Systems Management-March 1992
Advisor: Eric S. Theise-Department of Operations Research

The purpose of this thesis is to provide base Commanding Officers and communications managers with a non-technical overview of the Base Information Transfer System (BITS). This thesis will discuss the history, current status and implementation of BITS, a subarchitecture of a broad Navy program created to support Department of the Navy communications ashore. The intent is to consolidate various sources regarding BITS into one document and to provide information to aid in understanding how BITS relates to base communications. The study will define the scope of BITS and will examine its relationship to such global communications architectures as Copernicus. This thesis will also explore how BITS implementation will interface with other Navy, military, and worldwide communications systems. Separate chapters discuss how BITS implementation will influence acquisition, economics and equipment technology. This thesis will also describe the functional transfer of Activities Providing Telephone Service (APTS) as an example of one level of the overall BITS subarchitecture. Finally, the authors' conclusions are presented, and areas of possible concern are identified.

P-3 SQUADRON TRANSITION TO THE DEFENSE MESSAGE SYSTEM

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Master of Science in Telecommunications Systems Management
Advisor: Allan W. Tulloch-Department of Administrative Sciences

The Department of the Navy is currently implementing a new Department of Defense messaging system. This new system is the Defense Message System (DMS). DMS is designed to take advantage of the new advances in telecommunications and computer technologies, while phasing out existing inadequacies prevalent in the current DoD messaging system. The purpose of this thesis is to examine the current messaging system in terms of how it is utilized by a typical P-3 squadron. Both external and internal messaging processes will be examined. A detailed description of the DMS transition phases and major DMS components will be discussed, along with transition issues that will be of importance to the P-3 community. A basic summary of Local Area Networks (LANs) is provided, as well as a planning strategy for implementation of a LAN, with emphasis on the Navy PC-Lan contract.

SURVIVABILITY OF METEOR BURST COMMUNICATION UNDER ADVERSE OPERATING CONDITIONS

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B.A., Miami University, 1985
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Thomas Schwendtner-Department of Electrical and Computer Engineering

This thesis is a study of the survivability and reliability issues associated with operating meteor burst communication systems under adverse conditions. Meteor burst communication relies on the phenomenon of reflecting radio waves off the ionized trails left by meteors as they enter the atmosphere and disintegrate. The system's rapid deployment capability, mobility, and operating characteristics make it ideal for disaster and emergency communications. Adverse conditions such as ionospheric disturbances, polar region anomalies, sun-spot activity, the nuclear EMP environment, and others are discussed.

A CASE STUDY OF INFORMATION RESOURCE MANAGEMENT IN THE DEPARTMENT OF DEFENSE

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B.S., Computer Science, Oregon State University, 1986
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan C. Boger-Department of Administrative Sciences

This thesis develops a case study of a Department of Defense (DoD) activity that is suitable for presentation to military information resource management (IRM) students. The case will focus on the applicability of the Corporate Information Management (CIM) model as the framework for an IRM strategy for the Pacific Missile Range Facility (PMRF), Barking Sands, Hawaii. Presenting a case of organizational control and technical planning to future military managers will provide experience in analyzing problems that are unique to IRM in DoD. Use of this case study will also allow students to acquire skills in developing action plans for a military organization.

EVALUATION OF A BIOMETRIC KEYSTROKE TYPING DYNAMICS COMPUTER SYSTEM

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Master of Science in Telecommunications Systems Management-March 1992
Advisors: Judith H. Lind & Gary K. Poock-Department of Operations Research

This study evaluates an inexpensive personal computer access control device that relies on biometric keystroke typing dynamics technology, BioPassword Model 2100 (BioPassword). Enrollment time, verification time, false rejection error rate, false acceptance error rate, and user acceptance were evaluated for this system. The results show that BioPassword provides multilayer security through the inclusion of privilege control, audit functions, passwords, and verification of a personal behavioral characteristic, the rate and variation of typing a given password string. Enrollment and verification times were considered satisfactorily fast. Overall false rejection error rate was 22.5%, while false acceptance error rate was 3.4%. The false rejection error rates for acceptance as a function of trial number from one trial to five trials were 4.4%, 1.4%, 0.7%, 0.4%, and 0.3% respectively. These values were achieved under relatively uncontrolled conditions and should be improved on by using recommendations that are included. Users generally reported satisfaction with the system, which should be acceptable as part of an office automation system when used in conjunction with other standard security measures.

THE DEFENSE MESSAGE SYSTEM AND THE U.S. COAST GUARD

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Master of Science in Telecommunications Systems Management-June 1992
Advisor: Dan C. Boger-Department of Administrative Sciences

This thesis provides an overview of the Defense Message System (DMS) and the messaging related components of the Coast Guard Telecommunications System (CGTS). Also addressed are the seven-layer Open Systems Interface (OSI) Reference Model, the Government Open System Interconnection Protocol, and various interface devices such as bridges, routers, and gateways. The DMS Program is composed of a baseline architecture and three phases that will result in the transition from baseline systems and networks to a target architecture, with a goal for complete writer-to-reader messaging services. DMS baseline components, such as the Automatic Digital Network and components of the Defense Data Network, will either be phased out or transitioned into new architectures that will lead to the target architecture. The Coast Guard telecommunications organization is addressed as well as the broad aspects of the CGTS. A key issue of this thesis is to emphasize the importance of interoperability between the DMS and the CGTS through the use of approved standards and protocols.

THE ELECTROMAGNETIC PULSE ENVIRONMENT AND ITS INFLUENCE ON TACTICAL ELECTRONIC AND COMMUNICATIONS EQUIPMENT

Steven J. McGrath-Captain, United States Marine Corps
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Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan C. Boger-Department of Administrative Sciences

The purpose of this thesis is to aid the military communicator in understanding the phenomenon that is known as the electromagnetic pulse (EMP). This thesis includes a brief history and definition of the EMP and a description of the various EMP environments. It also discusses the effects that an EMP can have on exposed electronic components and communications equipment. It provides a description of the major approaches that are used to reduce the harmful effects of an EMP. A discussion of the factors considered in a cost/benefit analysis is included for the purpose of establishing cost and benefit considerations relevant to a system's evaluation. The thesis concludes that the decision of whether or not to protect electronic and communications equipment from an EMP depends on many factors, including the criticality of the equipment's mission and the cost of EMP hardening compared to the benefits received. It also concludes that the Nation should maintain its EMP hardening effort for critical systems.

AN OVERVIEW OF THE COPERNICUS C4I ARCHITECTURE

Robert Cruz Morales-Lieutenant, United States Navy
B.S., Mapua Institute of Technology, 1982
Master of Science in Telecommunications Systems Management-March 1992
and
Rebecca Dell Dearborn-Lieutenant, United States Navy
B.G.S., University of Iowa, 1979
Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan Boger-Department of Administrative Sciences

The purpose of this thesis is to provide the reader with an overview of the U.S. Navy's Copernicus C^{4}I Architecture. The acronym "C^{4}I" emphasizes the intimate relationship between command, control, computers, communications, and intelligence, as well as their significance to the modern day warrior. Never in the history of the U.S. Navy has the importance of an extremely flexible C^{4}I architecture been made more apparent than in the last decade. Included are discussions of the Copernicus concept, its command and control doctrine, its architectural goals and components, and Copernicus-related programs. Also included is a discussion on joint service efforts and the initiatives being conducted by the U.S. Marine Corps, the U.S. Air Force, and the U.S. Army. Finally, a discussion of the Copernicus Phase I Requirements Definition Document's compliance with the acquisition process as required by DoD Instruction 5000.2 is presented.

THE COMMUNICATION SUPPORT SYSTEM (CSS) AND ITS PLANNING AND MANAGEMENT UPON IMPLEMENTATION

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COPERNICUS is the Navy's C⁴I architecture envisioned to enhance command and control for the Composite Warfare Commander (CWC), Fleet Commanders-in-Chief (FLTCINCs) and, eventually, Unified CINCs. The Communication Support System (CSS) is both a system and architecture that will be instrumental in the realization of the Copernican TADIXS networks. The purpose of this thesis is to provide operations, communications and management personnel sufficient information regarding COPERNICUS and the CSS in order for them to have a basis for planning and managing CSS operations at its implementation.

FTS2000: FAILED INCENTIVES, LESSONS LEARNED

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B.S., United States Naval Academy, 1980
Master of Science in Telecommunications Systems Management-March 1992
Advisor: William R. Gates-Department of Administrative Sciences

The FTS2000 program provides the Federal Government with a nationwide long-haul telecommunications network incorporating voice, data, and video communications. Since its inception, controversy and Congressional inquiry have plagued the FTS2000 program and its managers at the U.S. General Service Administration. This thesis analyzes the reasons for FTS2000's management difficulties. The causes of difficulty analyzed include the role of stakeholders, especially Congress, poor incentives to the FTS2000 vendors, and technical difficulties in providing services. Following the analysis, recommendations are made for the improvement of the program. Changes in the contract structure to alter the incentives offered the FTS2000 vendors are proposed. The probable effect of these changes on the relations between the U.S. General Services Administration and Congress, the FTS2000 vendors, and the Federal user agencies is also analyzed.

CONSIDERATIONS FOR A SHIPBOARD MULTILEVEL SECURE LOCAL AREA NETWORK

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B.A., Tulane University, 1980
Master of Science Telecommunications Systems Management-March 1992
Advisor: Norman F. Schneidewind-Department of Administrative Sciences

This thesis investigates the possibility of implementing a multilevel secure local area network on a medium-sized ship. In particular it focuses on medium-sized ship communications suite connectivity to a GateGuard computer system, and then on incorporating systems that have been developed under the Navy's transition plan for the Defense Message System; specifically the Multilevel Mail Server being installed at Navy Telecommunications Centers. A review of data communications security considerations as well as DoD and Navy directives is provided for background on the accreditation requirements of multilevel secure systems. Additionally two commercially available products, the VERDIX Secure Local Area Network and Trusted Information Systems' XENIX trusted operating system are reviewed and then shown how they could potentially be integrated into a shipboard local area network. A potential configuration is provided with recommendation for further study of system application compatibility.

STATISTICAL PROCESS CONTROL TECHNIQUES FOR THE TELECOMMUNICATIONS SYSTEM MANAGER

Lee W. Schonenberg-Lieutenant, United States Navy
B.S., United States Naval Academy, 1983
Master of Science in Telecommunications Systems Management-March 1992
and
Joseph W. Beadles, III-Lieutenant, United States Navy
B.S., United States Naval Academy, 1985
Master of Science in Telecommunications Systems Management-March 1992
Advisors: Dan C. Boger & Sterling D. Sessions-Department of Administrative Sciences

The purpose of this thesis is to provide personnel, who are undergoing Total Quality Leadership (TQL) implementation at their telecommunications-related commands, an understanding of Statistical Process Controls (SPCs) and their potential application to telecommunication issues. Basic SPC tools common to all total quality programs are discussed. Advanced SPC methods including Analyses of Means (ANOM), Analysis of Variance (ANOVA), Weibull analysis and Taguchi methods are also presented. Selected SPC training programs of both the U.S. Navy and the commercial telecommunication industry are examined. A case study of a telecommunication-related issue is provided to demonstrate an integrated approach to the use of SPCs.

LINK-11 COMMUNICATIONS

Thor A. Simensen-Lieutenant, United States Navy
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The purpose of this thesis is to provide the reader with an overview of the Link-11 system and what telecommunication assets are needed to operate the system. Fundamental aspects of High Frequency (HF), Ultra High Frequency (UHF), and communication configurations are reviewed. An examination of the Link-11 equipment operations is presented with an in-depth review of the Data Terminal Set (DTS). The specific operations of the DTS that are studied are Error Detection and Correction (EDAC), audio signal generation, link protocol control, NTDS computer interface, and digital/analog conversion. Distinctive Link-11 communication features are discussed. These features consist of Phase Shift Keying (PSK), signal generation, signal structure, and binary encoding. The protocol, consisting of the frame structure, control codes, and net operation, which operates the net automatically is introduced. A review of radio equipment and its management concludes the thesis.

A COMPARISON OF ALTERNATIVE TRANSMISSION PATHS FOR ADMINISTRATIVE DATA FROM AFLOAT UNITS

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Master of Science in Telecommunications Systems Management-March 1992
Advisor: Dan C. Boger-Department of Administrative Sciences

This thesis considers the problems associated with moving high volumes of administrative data from afloat units to shore commands. It proposes three alternative technologies and compares them on the basis of effectiveness, reliability, ease of use, and cost. All three alternatives are based on collecting data on a shipboard microcomputer, compressing it, and transmitting it to a computer bulletin board system ashore where users can download data via commercial telephone lines. The primary difference between the three alternatives is in the transmission medium used. The first uses military satellite channels. The second uses High Frequency radio. The third uses INMARSAT, a commercial satellite communication system. All three alternatives are capable of effectively transferring data, but the best all-around performance was achieved with the INMARSAT-based system. Further consideration of variants on the system tested is recommended because the development of cost saving measures may make it highly competitive with current methods.

IMPLEMENTING TOTAL QUALITY LEADERSHIP IN A NAVAL COMPUTER AND TELECOMMUNICATIONS ACTIVITY

Deborah E. Youngblood-Lieutenant, United States Navy
B.A., Central State University, 1978
Master of Science in Telecommunications Systems Management-March 1992
Advisors: Susan Page Hocevar & Frank J. Barrett-Department of Administrative Sciences

The way that Total Quality Leadership (TQL) is implemented is unique to each command implementing it because it must be tailored to the command. However, some types of problems and pitfalls are more common than others. This thesis presents a case study of the implementation of TQL at one Naval Computer and Telecommunications Activity based on personal interview and command documentation. The implementation of TQL at this command is compared with a change process model and analyzed against it. Recommendations for corrections and alternative courses of action are provided.

ADVISOR INDEX

Abenheim, D.	292, 297, 299, 301, 302, 307
Abdel-Hamid, T.K.	135, 164
Adler, R.W.	98, 102
Agrawal, B.N.	15, 16, 41, 41
Atchley, A.A.	121, 348
Bailey, M.P.	57, 320, 323, 324, 329, 360
Baker, S.R.	59, 125
Ball, R.E.	129
Barnes, P.D.	369
Barr, D.R.	164, 185
Barrett, F.J.	146, 146, 191, 394
Berzins, V.	64, 70, 81
Bhargavi, H.K.	136, 138, 141, 163
Biblarz, O.	11, 25, 32, 39, 40, 42
Blount B.W.	200
Boger, D.C.	159, 178, 185, 206, 208, 209, 214, 233, 236, 237, 313, 325, 329, 365, 365, 378, 385, 385, 386, 387, 388, 389, 390, 391, 391, 393, 393, 394
Bourke, R. H.	283, 287
Bowman, W.R.	177, 225
Bradley, G.H.	331
Brown, D.A.	121, 174, 233, 236
Brown, R.M.	291, 291, 293, 376
Bui, T.X.	84, 137, 144, 144, 147, 155, 157, 157, 158, 158, 159, 160, 165, 165

Bundy, D.D. 164

Burl, J.B. 104, 110, 114, 157, 158

Buss, C.A. 294, 298, 303, 304, 306

Butler, J.T. 94

Caldwell, W.J. 321

Carrick, P.M. 174, 181, 203, 227, 230

Chen, W. 106

Chiu, C.S. 56, 278, 287, 338

Chu, P.C. 273, 278, 335, 339

Cleary, D.D. 43, 109, 353

Collins, C.A. 336

Collins, D.J. 3, 9, 25

Colson, W.B. 343, 344, 346, 347, 354

Conner, G.W. 330

Cooper, A.W. 99, 361

Coppens, A.B. 56, 57, 57, 121, 123, 124

Crawford, A.M. 178, 180, 182, 196, 198, 208

Cristi, R. 105, 105, 107, 113, 113

Crooks, R. 262, 264

Danielson, D.A. 51

Davidson, K.L. 4, 359

Davis, D.S. 130, 351

Dell, R.F. 314, 318, 319, 329, 330, 332

Denardo, B.C. 122, 126, 343, 349

Dolk, D.R. 58, 143, 143, 148, 155, 166, 173

Doyle, R.B. 197, 206, 208, 212, 215, 223, 230, 239

Driels, M.R. 246, 249, 266, 267

Dryer, D. 322

Durkee, P.A. 273, 279, 280, 280, 283, 284, 284, 285, 286

Dutta, I. 248, 256, 269

Eagle, J.N. 55, 323

Eberling, G.D. 197, 199, 200, 201

Ehret, L.L. 278

Eitelberg, M.J. 176, 198, 198

Elsberry, R.L. 278, 285

Elster, R.S. 240

Erickson, D. 143, 155, 166

Euske, K.J. 180, 196

Evered, R.D. 190, 191, 239

Fargues, M.P. 93, 96, 98

Fitzgerald, D.M. 186, 187

Fischer, I. 51

Fouts, D.J. 98

Fox, A.G. 132, 253, 257, 258, 260, 265, 270

Fremgen, J.M. 194, 195, 231

Frew, B.A. 136, 142, 154

Fu, Y.S. 370

Gardner, D.L. 121

Garrett, S.L. 343

Garwood, R.W. 281, 285

Gates, W.R. 171, 179, 196, 201, 204, 211, 213, 222, 223, 226, 228, 388, 392

Gaver, D.P. 314, 317

Gill, G. 359, 362

Glendening, J.W. 375, 377

Gorman, M.R. 6, 27, 27

Gorman, L. 218, 219, 226

Gragg, W.B. 50, 72

Ha, T.T. 110, 111

Haga, W.J. 138, 139, 146, 149, 151, 153, 156, 159, 163, 165

Harshman, R. 193, 202, 214, 226, 228, 235, 239

Healey, A.J. 245, 254, 259

Hebbar, S.K. 11, 29, 30, 130

Henson, V.E. 50, 316

Henderson, D.R. 229

Hippenstiel, R. 98, 108, 113

Hobson, G. 31, 35

Hocevar, S.P. 193, 209, 217, 218, 394

Hoffman, J. 321

Hofler, T.J. 368

Holt, T.R. 281, 286, 286

Howard, R.M. 10, 15, 28, 28, 28, 29, 31, 33, 36

Hsiao, D.K. 72, 76, 87

Hughes, W.P. 59

Jacobs, P.A. 314

Jenn, D.C. 95, 96, 107, 114, 116, 117

Jones, C.R. 146, 152, 154, 365, 365, 369, 378

Jones, L.R. 175, 188, 190, 196, 203 215, 225, 229

Joshi, Y. 252, 253, 260, 263, 266

Kalmar, L. 212, 220

Kalu, P.N. 249, 254, 255, 263

Kamada, R.F. 279, 348

Kamel, M.N. 137, 152, 161

Kanayama, Y. 63, 64, 65, 79, 82, 83

Kang, K. 171, 185, 210, 212, 224, 228, 229

Kelleher, M.D. 245, 256, 267, 267

Kemple, W.G. 324, 326, 326, 327, 328, 369

Kennedy-Minott, R. 302, 308

Knight R. 136, 148, 236

Knorr, J.B. 106

Kodres, U.R. 5, 50, 132

Kolar, R. 43, 44

Kraus, A.D. 97, 101, 112

Kwak, S.H. 77

Kwon, Y.W. 245, 246, 247, 250, 259, 264

Lam, A.W. 101, 102, 117

Lamm, D.V. 172, 178, 179, 182, 186, 202, 213, 224, 226, 227

Larson, H.J. 322, 326

Larraza, A. 122, 126, 349

Laurance, E.J. 293

Lawphongpanich, S. 316, 329, 332

Lee, C.H. 92

Lee, H.M. 93, 99

Lee, Y.J. 66, 69, 73, 82

Levien, F.H. 116

Lewis, P.A. 57

Liao, S.S. 150, 164, 167

Ligrani, P.M. 252, 261, 269

Lind, J.H. 58, 209, 328, 377, 390

Lindsay, G.F. 313, 323

Lindsey, G.H. 26, 35

Loomis, H.H. 100, 118

Lundy, G.M. 65, 73, 74, 74, 77, 80, 81

Luqi, L. 5, 70, 75, 78

Magnus, R. H. 293, 303

Marshall, K.T. 60, 319, 322

Marto, P.J. 251, 252, 253, 257, 260, 266

Maruyama, X.K. 345, 346, 350, 353, 355

Matsushima, R.F. 137, 177, 182, 185, 186, 195, 200, 210, 213, 216, 221, 224, 230, 234, 234, 234, 238

McCaffery, J. 183, 198, 203, 212, 214, 217, 220, 229, 232

McCaffery, M. 140, 149, 150, 156, 162, 176, 184, 221

McLain, D.R. 336

McMasters, A.W. 174, 181, 188, 189, 192, 204, 219, 224, 233

McNelley, T.R. 131, 246, 247, 249, 250, 254, 255, 255, 262, 263, 264

Mehay, S.L. 177, 182, 194, 198, 205, 216, 219

Melese, F. 172

Memory, S.B. 251, 252, 253, 257, 260, 266

Michael, S. 104

Milch, P.R. 332

Miller, J.H. 58, 122, 123, 336

Mitra, S. 129, 248, 268, 269

Moore,T.P. 149, 171, 189, 192, 204, 216, 223, 241

Moses, O.D. 237

Nakagawa, G. 138

Neil, G.R. 354

Nelson, M.L. 71, 71, 80, 82, 84

Neta, B. 51

Netzer, D.W. 30, 36, 39, 43, 45, 129

Nevels, J.M. 238

Newberry, C.F. 131

Nuss, W.A. 277, 279

Nystuen, J. 124, 125, 287, 338

Olsen, R.C. 344, 346, 350, 352, 352

Paduan, J. 337

Panholzer, R.P. 93, 115

Papoulias, F.A. 130, 250, 258, 261, 265, 268, 269

Parry, S.H. 315, 330

Paulo, E.P. 332

Petho, D. 316

Platzer, M.F. 9, 11, 16, 26, 130

Poock, G.K. 157, 158, 366, 367, 377, 390

Powers, J.P. 91, 92, 94, 115

Pratt, D.R. 68

Purdue, P. 327

Ramesh, B. 81, 135, 135, 139, 145, 163

Ramp, S.R. 277

Rasmussen, C.W. 49

Read, R.R. 315, 320, 320, 323

Roberts, B.J. 191, 211, 219

Roberts, N.C. 194, 217, 366

Robertson, R.C. 100, 110, 111

Robinson, G.E. 295

Rosenthal, R.E. 49, 314, 315, 316, 318, 328

Ross, I.M. 17, 42, 44

Rowe, N.C. 4, 63

Salinas, D. 247, 259, 261, 262, 270

Sanders, J.V. 121

San Miguel, J.G. 173, 180, 192, 211, 222, 231

Sarpkaya, T. 251, 254

Scandrett, C. 50, 56

Schmidt, L.V. 3, 17, 30

Schneidewind, N.F. 142, 392

Schwendtner, T.A. 389, 393

Schwirzke, F.R. 352, 354

Semtner, A. 281

Sengupta, K. 137, 141, 146, 151, 152, 153, 160, 166

Sessions, S. 385, 393

Shimeall, T.J. 77

Shin, Y.S. 248, 260, 265

Shing, M. 67, 79, 359

Shreeve, R.P. 35, 40

Shukla, S. 91, 95, 103, 103, 104, 108, 109, 360

Sohn, S.Y. 207, 381

Sovereign, M.G. 326, 368, 370, 371, 375, 392

Stanton, T.P. 335

Stemp, R. 161, 165

Stockton, P.N. 298, 301, 308

Stolfi, R.H.S. 184, 304

Suchan, J.E. 218

Suh, M.W. 162, 175, 205, 370, 387

Terasawa, K. 196, 201, 204

Teti, F.M. 295, 300, 309

Theise, E.S. 366, 376, 386, 388

Therrien, C.W. 96, 111

Thomas, G.F. 232

Thomas, G.W. 179, 183, 187, 207, 218, 226, 235, 317

Thomas, K.W. 158, 232

Thornton, E.B. 337

Titus, H.A. 101, 106, 116

Tollefson, S.D. 296, 296, 297, 299, 303, 306

Trietsch, D. 190, 197, 211

Tritten, J.J. 292, 296, 305, 305

Tsypkin, M. 295, 300, 307, 310

Tulloch, A.W. 205, 389

Tummala, M. 21, 99, 105, 110, 117

Vincent, W.R. 91

Wadsworth, D.V. Z. 112, 361

Walsh, W.J. 367, 371, 372

Walters, D.L. 345, 347, 349, 351

Wash, C.H. 55, 273, 280, 282

Whipple, D.R. 199

Whitaker, L.R. 314, 325, 327, 331, 332

Wight, R. 111, 381

Williams, R.T. 282

Williams, S.M. 92, 97

Winterford, D 291, 297, 302, 309, 310

Wirtz, J. 294

Wood, E.R. 10, 32, 33, 34, 34

Woods, W.M. 327

Wu, C.T. 63, 66, 75, 76, 87, 147

Wu, F M. 40, 248

Yang, C. 100, 107, 114, 118, 362

Yost, D.S. 301, 306

Zaky, A. 69, 83

Ziomek, L.J. 123, 126

Zirschky, Stephen 175, 177, 180, 209, 220, 231, 234, 234, 240

Zviran, M. 141, 153, 156

Zweig, D. 140, 145

Zyda, M.J. 64, 67, 68, 68, 78, 78, 83, 85, 85, 86, 86, 87

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