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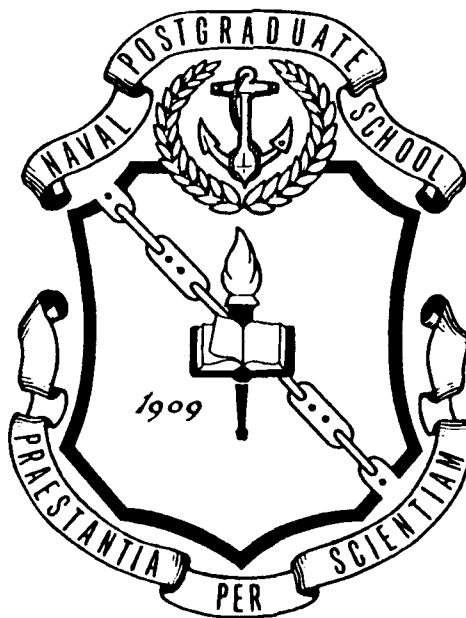
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COMPILATION OF ABSTRACTS
OF THESES SUBMITTED BY
CANDIDATES FOR DEGREES

OCTOBER 1988 TO SEPTEMBER 1989

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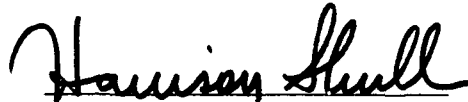
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NAVAL POSTGRADUATE SCHOOL
Monterey, California

At the Naval Postgraduate School, most of the curricula in which advanced degrees are offered require the submission of an acceptable thesis.

This publication contains unclassified abstracts of theses submitted for the degrees of Doctor of Philosophy Engineer, Master of Science, and Master of Arts during the period of 1 October 1988 - 30 September 1989.

This compilation of abstracts of theses is published in order that those interested in the fields represented may have an opportunity to become acquainted with the nature and substance of the student research that has been undertaken. Copies of theses are obtainable for those wishing more detailed information according to the procedures outlined on the following page.

The Naval Postgraduate School wishes to acknowledge Jodie Young of the Research Administration Office for her efforts in the production of this book.

Additional information about programs and curricula at the Naval Postgraduate School can be obtained from the Director of Programs, Code 03. For further information about student and faculty research at the school, contact the Director of Research Administration, Code, 012, Naval Postgraduate School, Monterey, CA. 93943.

NAVAL POSTGRADUATE SCHOOL
Monterey, California

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DOCTOR
OF
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CONSTRUCTION OF OPTIMAL-PATH MAPS FOR HOMOGENEOUS COST REGION PATH PLANNING PROBLEMS

Robert Steven Alexander - Major, United States Army
B.S., United States Military Academy, 1974
M.S., Naval Postgraduate School, 1986
Doctor of Philosophy in Computer Science - September 1989
Advisor:N.C. Rowe - Department of Computer Science

Fast path-planning algorithms are needed for autonomous vehicles and tactical terrain-analysis tools. We explore a new approach using "optimal-path maps," that give the best path to a goal point from any given start point in cross country two dimensional terrain for a moving agent of negligible size. Such maps allow fast point-location algorithms at run-time to categorize a start point's optimal path to the goal, from which the path can be reconstructed. We study terrain modelled by piecewise-linear roads and rivers, polygonal obstacles, and by convex polygonal homogeneous cost areas (weighted regions). We explore two methods for constructing optimal paths maps, one based on wavefront propagation point to point path planning, and more exact divide and conquer algorithm that reasons about how optimal paths must behave. In the more exact approach, boundaries caused by terrain features are characterized using analytical geometry and optimal path principles, and partial optimal path maps are merged into complete ones.

BAROTROPIC VORTEX ADJUSTMENT TO ASYMMETRIC FORCING WITH APPLICATION TO TROPICAL CYCLONE MOTION

Lester E. Carr
Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1977
Doctor of Philosophy in Meteorology - September 1989
Advisor: R.L. Elsberry - Department of Meteorology

A nondivergent, barotropic analytical model to predict steady tropical cyclone (TC) propagation relative to the large scale environment is developed in terms of a "self advection" process in which the TC is advected by azimuthal wavenumber one gyre flow that results from TC-environment interaction. The model is comprehensive in that it include the first-roder effects of all of the dynamical influences that are presently understood to be important to barotropic propagation: gradients of planetary and environmental vorticity, changes in TC wind structure, and environmental windshear. An unforced version of the model is used to show that angular wind-shear in the symmetric TC circulation acts to damp perturbation from axisymmetry by tilting the perturbations downshear. The resultant transfer of kinetic energy from perturbation to symmetric circulation thus trends to restore axisymmetry. Thus, steady propagation of TC like barotropic vortices is a manifestation of a stable response to asymmetric forcing. To predict both the asymmetric gyre flow and the propagation it induces, the forced Barotropic Self Advection Model (BSAM) is closed by seeking a particular pattern in the vorticity tendencies of the TC-environmental interaction flow. For realistic combinations of environmental vorticity gradients and linear windshear, the BSAM predicts propagation speeds and directions that are consistent with TC propagation characteristics observed in composite data. The capability of the BSAM to account for variable TC structure is used to show that errors in determining TC outer wind strength of ± 1 m/s can result in an 85 km forecast error at 48 h. Finally, and most importantly, the capability of the BSAM to initialize a barotropic numerical model so that quasi-steady TC propagation occurs almost immediately is demonstrated for several simple dynamical situations.

DEVELOPMENT OF A LARGE-SCALE COUPLED SEA ICE MODEL FOR INTERANNUAL SIMULATIONS OF ICE COVER IN THE ARCTIC

Gordon H. Fleming - Lieutenant Commander, Canadian Navy
B.Sc., Royal Roads Military College, 1978
Master of Science, Naval Postgraduate School, 1987
Doctor of Philosophy in Physical Oceanography - September 1989
Advisor: A.J. Semtner - Department of Oceanography

A coupled ice-ocean numerical model is developed which improves the simulation of the annual cycle and interannual variations in ice cover in the Arctic. The model is a further development of the work by Semtner (1987). Although the accuracy of the simulated ice concentration is increased, the annual cycle of ice coverage is still exaggerated. Several experiments are conducted to determine the importance of incorporating a fully interactive ocean, to select an optimum strength parameter for use in the ice rehelogy, to investigate the model's sensitivity to changes in the albedo of the frozen surface and to determine the relative importance of the various dynamic and thermodynamic forcing mechanisms. The regional dependence of these mechanisms and an assessment of two statistical analysis techniques used to measure model improvement are also examined. Inclusion of a fully prognostic ocean component vice a ten year mean ocean cycle in the model improves the correlation of simulated ice concentration fields which observed data. This is the case for all regions in the Arctic; for both the annual cycle and interannual variations of the ice cover. A reduced strength parameter value, $P^* = hx104$, is found to improve the simulation of the ice thickness distribution with increased overall thickness and better compression North of the Canadian Archipelago and Greenland. In contract to results using ice models without a fully prognostic ocean component, this model is quite insensitive to changes in the frozen surface albedo. Exceptions are evident where the ocean heat flux into the mixed layer is small and the ice is thin. At the spatial (110 km) and temporal (monthly) scales used here, the heat provided by the ocean appears to be the dominant mechanisms controlling the position of the ice edge and the extent of the ice pack. With the pack, it is the dynamic forcing and, in particular, the wind forcing which control the ice thickness distribution. The ocean circulation below the mixed layer appears to position the heat underneath the MIZ. The MIX is also the region where the ice thickness tends to decrease through divergence. The linkage between the subsurface heat and the thinned ice cover is apparently controlled by conditions at the surface and the resulting response of the mixed layer.

DYNAMIC FACTORIZATION IN LARGE-SCALE OPTIMIZATION

Michael Paul Olson
Commander, U.S. Navy
B.S., U.S. Naval Academy, Annapolis, Maryland, 1974
M.S., Naval Postgraduate School, 1988
Doctor of Philosophy in Operations Research - June 1989
Advisor: G.G. Brown - Department of Operations Research

Factorization is an approach to linear programming (LP) in which the algebraic elements of the LP tableau are organized in such a way that a large portion of the tableau may be represented implicitly and generated from the remaining explicit part. In dynamic row factorization, the row structure of the LP model instance influences the algebraic structure of the tableau, and the dimension of the algebraic elements may change as the solution progresses. We present three algorithms motivated by this approach, each resulting from a different LP model row structure; generalized upper bound (GUB) rows, pure network rows and generalized network rows. We describe implementation of all three algorithms, specifying data structures for tableau and basis inverse representations and detailing procedures for manipulation and update of these representations. Computational results are presented for a number of real-world models taken from a variety of applications and industries. From each model, one or more particular instances are solved by each of our three implementations and by a commercial quality mathematical programming system. The characteristics of the four solvers are compared and contrasted. Previous research on related algorithms by others suggests that these algorithms are properly viewed as specialized approaches, useful only on narrow classes of problems. Our computational results strongly refute this view, and instead suggest that each algorithms is superior to the general simplex approach on a wide range of problem classes and structures.

PLANNING MINIMUM-ENERGY PATHS IN AN OFF-ROAD ENVIRONMENT
WITH ANISOTROPIC TRAVERSAL COSTS AND MOTION CONSTRAINTS

Ron S. Ross - Major, United States Army
M.S., Naval Postgraduate School, 1982
Doctor of Philosophy in Computer Science - June 1989
Advisor: R.B. McGhee - Department of Computer Science

For a vehicle operating across arbitrarily contoured terrain, finding the most fuel efficient route between two points can be viewed as a high level global path planning with traversal costs and stability on the direction of travel anisotropic. The problem assumes a two dimensional polygonal map of homogeneous cost regions for terrain representation constructed from elevation information. The anisotropic energy cost of vehicle motion has a non-braking component dependent on horizontal distance, a braking component dependent on vertical distance, a braking component dependent on vertical distance, and a constant path independent component. The behavior of minimum energy paths is then proved to be restricted to a small, but optimal set of traversal types. An optimal path planning algorithms, using a heuristic search technique, reduces the infinite number of paths between the start and goal points to a finite number by generating sequences of "goal feasible" window lists from analysis, heading analysis, and region boundary constraints. Each goal feasible window list specifies an associated convex optimization problem, and the best of all locally optimal paths through the goal feasible window lists is the globally optimal path. These ideas have been implemented in a computer program, with results showing considerable better performance than the exponential average case behavior predicted.

SATELLITE MOTION AROUND AN OBLATE PLANET:
A PERTURBATION SOLUTION FOR ALL ORBITAL PARAMETERS

James Ralph Snider - Lieutenant Colonel, United States Army
B.S., United States Military Academy, 1979
M.S., Naval Postgraduate School, 1979
Doctor of Philosophy in Aeronautical Engineering - June 1989
Advisor: D.A. Danielson - Department of Mathematics

The search for a universal solution of the equations of motion for a satellite orbiting an oblate planet is a subject that has merited great interest because of its theoretical implications and practical applications. The discovery of such a solution should motivate a reassessment of both the theories that exhibit singularities and the physical effects implied by singularities. The practical importance of such a solution is the efficiency of simple analytic formulas in predicting simultaneously the paths of large numbers of satellites in a multitude of orbits. Here, a complete first order solution to the problem of a satellite, perturbed only by the oblateness of the Earth, is displayed. The orbit is free of singularities for all parameters and is valid for 1000 revolution with a relative error of the order J2-a0-6.

AERONAUTICAL ENGINEER

THE EFFECTS OF NOZZLE GEOMETRY ON PARTICLE SIZE DISTRIBUTION IN A SMALL TWO DIMENSIONAL ROCKET MOTOR

William Dennis Brennan - Lieutenant, United States Navy
B.S., United States Naval Academy, 1982
Aeronautical Engineer - September 1989
Advisor: D.W. Netzer - Department of Aeronautics and Astronautics

Laser diffraction particle sizing was conducted at the nozzle entrance, inside the nozzle, and in the exhaust plume of a small two-dimensional rocket motor using two different metallized propellants to determine the effects of nozzle geometry on particle breakup. Six different nozzles were used, including three converging nozzles and three converging/diverging nozzles. An AP/GAP/Al propellant containing 4.69 percent aluminum showed no significant effects o nozzle geometry on exhaust plume particle size. Exhaust plume measurements showed consistent results under various conditions, indicating that the particle breakup had been completed at the nozzle throat. The particle size distribution was successfully tracked through the motor for one particular converg-ing section, with particle breakup inside the nozzle occurring prior to that predicted by theoretical analysis. An AP/HTPB/ZrC propellant containing 1.0 percent zirconium carbide exhibited particle size variation in the exhaust plume, but sparse data and varying combustion chamber pressures precluded isolation of the casual factor. Additionally, combustion chamber pressure was shown to decrease measured particle size inside the motor for both propellants. Extensive particle sizing validation experiments using particles of known size suspended in distilled water were conducted throughout the course of the investigation to assist interpretation of laser diffraction particle sizing data.

PARTICLE SIZING IN SOLID ROCKET MOTORS

Douglas Lyle Hovland - Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1977
Aeronautical Engineer - March 1989
Advisor: D.W. Netzer - Department of Aeronautics and Astronautics

Particle size distribution measurements were made with a Malvern 2600c forward laser light diffraction system across the exhaust nozzle entrance and exhaust plume of a small two-dimensional rocket motor. The solid propellants tested were GAP propellants containing 2.0% and 4.69% aluminum. Surface agglomeration of the aluminum, indicated by the in-motor results, was found to decrease as the motor chamber pressures were increased. At low pressures, increasing the aluminum loading with fixed total solids decreased the mean particle size at the nozzle entrance. Exhaust plume particle size was practically independent of nozzle inlet particle diameters supporting the critical Weber number particle breakup theory. Initial validation of the Mavern 2600c measurements was accomplished by favorable comparison to exhaust plume particle distribution results obtained using a particle collection probe.

AUTOMATION AND EXTENSION OF LDV MEASUREMENTS OF OFF-DESIGN FLOW IN A CASCADE WIND TUNNEL

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B.S., United States Naval Academy, 1982
Aeronautical Engineering - June 1989
Advisor: R.P. Shreeve - Department of Aeronautical and Astronautical

A two component laser-Doppler velocimetry system was successfully automated to speed the data acquisition and reduction process for flow measurement in a subsonic linear cascade wind tunnel. A three-axis traverse table was installed for computer controlled positioning of the LDV probe volume and a modification was made to permit measurements close to test blade surfaces. Commercial software was used for control and acquisition of the LDVd data. Software was generated in-house to record tunnel conditions and reduce and present the survey data. Detailed measurements were made of the flow through a controlled diffusions compressor cascade at an inlet flow angle of 48 degrees (8 degrees above design) to extend a database for viscous code validation. Test conditions were held nominally at M-0.25 and Rec=72000. The flow was shown to remain attached at the blade trailing edge, but the measurements also indicated the presence of a less stable flow field in the blade passage when compared with previous observations at lower inlet flow angles.

REVIEW AND EVALUATION OF A TURBOMACHINERY
THROUGHFLOW FINITE ELEMENT CODE

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B. Engineer, University of Singapore, 1981
Aeronautical Engineer - June 1989
Advisor: R.P. Shreeve - Department of Aeronautics and Astronautics

The finite element code Q3DFLO'81 was elevated to determine its suitability for use in a program to investigate axial compressor tip clearance effects. The code was first applied to Dring's fully comprehensive benchmark data set in order to validate the numerical modelling free of experimental uncertainties. It was then applied to the Naval Postgraduate School axial research compressor with which tip clearance effects were to be investigated experimentally. The evaluation identified both limitations in the code and limitations in the data which could be obtained in the experiment. It was recommended that provision be made to accommodate peripherally non-uniform flow effects (blockage) in the throughflow code calculation, and that provision be made to obtain adequate peripheral flow surveys in the experiment.

ELECTRICAL ENGINEER

NEURAL NETWORKS APPLIED TO SIGNAL PROCESSING

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Electrical Engineer and Master of Science
in Electrical Engineering - September 1989
Advisor: M. Tummala - Department of Electrical & Computer Engineering

The relationship between the structure of a neural network and its ability to perform nonlinear mapping is analyzed. A new algorithm, called the conjugate gradient optimization method, for calculating the weights and thresholds of a neural network is presented. The performance of the conjugate gradient algorithm is then compared to the well known back propagation method and shown to be more computationally efficient. A neural network using the conjugate gradient algorithm is then applied to three simple examples to demonstrate its signal processing capabilities. The first example illustrates the ability of the neural network to perform classification. The second compares the performance of a one step linear predictor to a neural network for a nonlinear chaotic time series. The neural network predictor is shown to provide much greater accuracy than its linear counterpart. The final application presented demonstrates the ability of a neural network to perform channel equalization for a nonminimum phase channel. Its performance is then compared to its linear equivalent.

CONTROL OF AN EXPERIMENT TO MEASURE ACOUSTIC NOISE IN THE SPACE SHUTTLE

Charles B. Cameron
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B.S., University of Toronto, 1977
Electrical Engineer and Master of Science
in Electrical Engineering - June 1989
Advisor: R. Panholzer - Space Systems Academic Group

This thesis describes the potential use of general purpose controller autonomously to measure acoustic vibration in the Space Shuttle Cargo Bay during launch. The experimental package will be housed in a Shuttle Get Away Special (GAS) canister. We have implemented the control functions with software written largely in the C programming language. We use an IBM MS/DOS computer and C cross-compiler to generate Z-80 assembly language code, assemble and link this code, and then transfer it to EPROM for use in the experiment's controller. The software combines that experimental control functions with a menu-driven, diagnostic subsystem to ensure that the software will operate in practice as it does in theory and under test. The experiment uses many peripheral devices controlled by the software described in this thesis. These devices include: a solid state data recorder, a bubble memory storage module, a real time clock, an RS-232C serial interface, a power control subsystem, a matched filter subsystem to detect activation of the Space Shuttle's auxiliary power units five minutes prior to launch, a launch detection subsystem based on vibrational and barometric sensors, analog-to-digital converters, and a heater subsystem. The matched filter design is discussed in detail in this thesis, and the results of a computer simulation of the performance of its most critical sub-circuit are presented.

REAL TIME ADAPTIVE CONTROL OF AN
AUTONOMOUS UNDERWATER VEHICLE (AUV)

Michael H. Davis
Lieutenant, United States Navy
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Electrical Engineer and Master of Science in
Electrical Engineering - September 1989
Advisor: R. Cristi - Department of Electrical and Computer Engineering

In this research, the problem of designing a controller for the dive maneuver of an Autonomous Underwater Vehicle (AUV) is addressed. The highly nonlinear nature of the vehicle dynamics and the requirement for robust control techniques. In particular, Variable Structure Control (VSC) combined with Adaptive Control (AC) techniques seem to yield satisfactory performance in terms of robustness, ability to adjust to different operating conditions, and speed of response. Also, linear robust techniques based on LQG and robust observers are presented to address the case when the whole state (in terms of pitch rate, pitch, and depth) is not available for measurement.

PERFORMANCE OF RADAR RECEIVERS IN THE PRESENCE
OF NOISE AND INTENTIONAL INTERFERENCE

Panagiotis G. Mavropoulos
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B.S., Hellenic Army Academy, 1978
Electrical Engineer and Master of Science
in Electrical Engineering - December 1988
Advisor: D.C. Bukofzer - Department of Electrical and Computer Engineering

This thesis is devoted to analyzing the problem of masking a reflected radar signal, in order to degrade the radar receiver's performance. This is to be accomplished by appropriately choosing the Power Spectral Density (PSD) of a power constrained colored noise interference to be generated either by the target itself or by pre-positioned "friendly" noise makers. The goal in either case is to generate interference signals and results in decreased receiver probability of detection, PD, for a given receiver probability of false alarm, PF. Efforts to identify appropriate PSD's of the power constrained inter-ference were carried out by evaluating the receivers' PD as a function of PF for two specific target models. The performance results for the various receivers investigated demonstrate that the noise interference generated by the noise makers can achieve significant levels of degradation, while the target generated noise interference intends to improve rather than degrade the radar receiver's performance. In all cases, considered, the sinc squared shaped noise interference PSD is more effective at degrading the receiver performance than any other kind of PSD analyzed.

INSTANTANEOUS POWER SPECTRUM

Paulo M.D. Monica de Oliveria
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B.S., Portuguese Naval Academy, 1982
Electrical Engineer and Master of Science
in Electrical Engineering - March 1989
Advisor: R.D. Hippenstiel - Department of Electrical Engineering

The need for tools capable of handling non stationarities in the spectral content of the data has been recognized as early as 1946. The Winder-Ville Distribution (WD) has been extensively used since its introduction in 1948, but suffers from some associated problems (e.g., spectral cross-terms and requiring the use of analytic signals). An alternative Distribution is proposed, which has its origin in the definition proposed by Page of "Instantaneous Power Spectrum" (IPS). Its characteristics are examined, and when pertinent, compared to the WD. It is shown to be less sensitive to the problems afflicting the WD, but provides less frequency resolution. The usefulness of a parametric (AR) version is investigated. Some typical test signals are examined to demonstrate the performance and trade-offs of IPS and its parametric version.

ADAPTIVE TWO DIMENSIONAL RLS ALGORITHMS

Armando M.P. de Jesus Sequeria
Lieutenant, Portuguese Navy
B.S.E.E., Portuguese Naval Academy, 1981
Electrical Engineer and Master of Science in
Electrical Engineering - March 1989
Advisor: C.W. Therrian - Department of Electrical & Computer Engineering

A Two-Dimensional Fast Recursive Least Squares (2-D FRLS) algorithms is presented using a geometrical formulation based on the mathematical concepts of vector space, orthogonal projection, and subspace decomposition. By appropriately ordering the 2-D data, the algorithm provides an exact least squares solution to the deterministic Normal equations. The method is further extended to the general FIR Wiener filter and ARMA modeling. The size and shape of the support region for both the MA and AR coefficients of the filter can be chosen arbitrarily. The ARMA parameter estimation problem is also considered for the case when the system input is not available. Computer simulations are presented to illustrate the applications of the algorithm for 2-D parameter estimation, system identification and image coding.

MECHANICAL ENGINEER

A MICROSTRUCTURAL INVESTIGATION OF THE SHEAR DISTORTIONS AND ENERGETICS OF MOTIONS OBSERVED IN AGED HIGH DAMPING 53Cu-45Mn-2Al Alloy

David Michael Farkas
Lieutenant Commander, United States Navy
B.S.M.E., Purdue University, 1976
Mechanical Engineer and Master of Science
in Mechanical Engineering - March 1989
Advisor: A.J. Perkins - Department of Mechanical Engineering

The shear distortions developed upon aging of a 53Cu-45Mn-2Al alloy were studied using transmission electron microscope image extinctions and diffraction spot streak analysis. It was determined that a lattic distortion of {110} planes, in <111> directions developed in the alloy as aging progressed. This matured <111> shear induces a distinct V-shaped contrast which displays dynamic motion under the electron-beam irradiation of TEM examination. Video imaging techniques were applied to this dynamic activity, termed "flickering," to investigate the energetics of the underlying crystalline lattice motion. The real-time behavior at the flicker sites suggests that the underlying mechanism which produces the dynamic contrast changes is a gradual crystallographic transition, typical of a second-order phase transition. The flicker contrast motion displayed many of the characteristics of "chaotic vibrations."

NATURAL CONVECTION LIQUID IMMERSION COOLING OF HIGH DENSITY COLUMNS OF DISCRETE HEAT SOURCES IN A VERTICAL CHANNEL

Alfred O. Gaiser
Lieutenant, United States Navy
B.E., Steven Institute of Technology, 1983
Mechanical Engineer - June 1989
Advisor: Y. Joshi - Department of Mechanical Engineering

Natural convection liquid cooling of simulated electronic components in a vertical channel was investigated. The test surface consisted of three columns of fifteen flush mounted foil heaters. The channel was formed by placing a smooth movable shrouding wall parallel to the test surface. The experimental procedure called for temperature measurements and flow visualization at various power levels and channel spacings. Surface temperatures of each heat source were measured using a centrally located embedded thermocouple. Temperature measurement within the flow was conducted using a thermocouple probe. Flow visualization was conducted with the use of a laser generated plane of light. A visual temperature profile of the board was developed through the use of liquid crystals. From the data obtained, experimental correlations relating the local heat transfer properties with shroud wall spacing and strip heater power levels were developed.

MODEL BASED DESIGN AND VERIFICATION OF A RAPID DIVE CONTROLLER FOR AN AUTONOMOUS UNDERWATER VEHICLE

Gordon S. MacDonald
B.S., United States Naval Academy, 1973
Mechanical Engineer and Master of Science
in Mechanical Engineering - March 1989
Advisor: A.J. Healey - Department of Mechanical Engineering

Autonomous Underwater Vehicles are being considered today by many organizations as a low cost substitute for manned vehicles. Requirements for autonomy emphasize the need for a robust system controller that can adequately maneuver the vehicle and ensure precise tracking of a planned path. This thesis presents the determination of hydrodynamic coefficients for vertical motion of a radio controlled underwater vehicle based on open loop testing. The equations of motion were manipulated using software Matrix-x to create a satisfactory closed loop control system for rapid maneuvering in the vertical plane. Because vehicle data provided by on-board sensors was limited, both state estimation and disturbance estimation/compensation techniques were used, leading to a model based compensator which enhanced control. Results show that a satisfactory closed loop control design can be achieved using these modern controller design techniques. The extension to the design of steering control is addressed.

FREE SURFACE SCARS AND STRIATIONS

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Commander, United States Navy
B.S., United States Naval Academy, 1974
Mechanical Engineer and Master of Science
in Mechanical Engineering - June 1989
Advisor: T. Sarpkaya - Department of Mechanical Engineering

A numerical and experimental investigation of the interaction of a pair of vortices with a free surface has been undertaken. The analysis is based on the vortex-sheet representation of the free surface and the use of the appropriate boundary conditions. The experiments were performed in a large basin and the vortices were generated through the use of a special nozzle. The rise of the resulting Kelving oval, the trajectories of the vortices, and the instantaneous shape of the free surface were recorded on a video tape and then carefully analyzed thorough the use of a Motion Analysis system. The results have shown that the rise of the vortices not only gives rise to two scars, with a pronounced hump in the middle, but also, and more importantly, to a three-dimensional instability heretofore unknown. The measured and calculated vortex trajectories and the free surface shapes at the corresponding times and Froude numbers are found to be in reasonable agreement. The new instability will form the basis of future investigations.

MASTER OF SCIENCE
IN
AERONAUTICAL
ENGINEERING

FLIGHT TEST METHOD DEVELOPMENT FOR A QUARTER SCALE AIRCRAFT WITH MINIMUM INSTRUMENTATION

Nicolaos D. Bamichas
Captain, Hellenic Air Force
Master of Science in Aeronautical Engineering - March 1989
Advisor: R. Howard - Department of Aeronautical Engineering

A flight test method was developed for a quarter scale model aircraft with minimum onboard instrumentation for the determination of the Drag Polar, the Thrust Required curve, and the Power Required curve. The test included a wind tunnel test for propeller efficiencies and thrust coefficients, a torque test for engine shaft horse-power, and a flight test for flight speeds at measured operating conditions. The only additional onboard instrumentation besides that for radio control was a small cassette recorder. Two methods are described for data manipulation and an error analysis is provided for each method.

FLOW VISUALIZATION OF DYNAMIC STALL ON AN OSCILLATING AIRFOIL

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Stroboscopic schlieren photography was used to investigate the effects of compressibility, reduced frequency, and amplitude on the dynamic stall of a NACA 0012 airfoil subjected to sinusoidal oscillation. The Mach number was varied form M $=0.25$ to M $=0.45$ (corresponding to Reynolds number variation of Re $= 450,000$ to Re $= 810,000$); the reduced frequency was varied from K $= 0.025$ to K $= 0.10$. Oscillation amplitudes of m $= 10$ were compared. Schlieren photographs are presented, which document the dynamic stall vortex formation, convection, and shedding sequence for various experimental conditions. Additionally, a preliminary examination of the flow reattachment process was conducted. Data derived from the photographs indicates that increasing the compressibility causes dynamic frequency and/or the oscillation amplitude effectively delay dynamic stall effects to a higher angle of attack. Flow reattachment is sensitive to both Mach number and reduced frequency for low values of these parameters; when either the Mach number or reduced frequency is sufficiently high, the reattachment process stabilizes.

OFF-DESIGN LOSS MEASUREMENT IN A COMPRESSOR CASCADE

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Data acquisition software was written to recover the ability to make loss measurements using a five-hole pneumatic probe in a wind tunnel facility currently containing a modeled subsonic cascade of controlled diffusion (CD) stator blades. Acquisition, reduction and ancillary programs were written for a Hewlett Packard 9000 Series 300 computer/HP 3052 Data Acquisition System in HP BASIC 5.0. The new software was demonstrated and validated by conducting a set of surveys at the (near to stall) air inlet flow angle of 48 degrees. The survey results showed a diminishing core of two-dimensional flow through the blading due to side wall boundary layer effects and integration of upstream and downstream measurements gave an axial velocity-density ration of 1.108 and a NASA loss coefficient if 0.097. Prior to the surveys, the probe was calibrated in a free jet facility, thus also revalidating the calibration software. It was concluded that the facility instrumentation and procedures were now in place for making accurate off-design loss measurements on a routine basis.

COMPOSITE FAILURE CRITERION - PROBABILISTIC FORMULATION AND GEOMETRIC INTERPRETATION

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The objective of this investigation is to derive reliability and the associated probabilistic failure criterion for composite materials under combined stress. In the analytical derivation, the concept of joint probability was used and applied to the Weibull distribution function. In applications, given the experimental measurements of the necessary statistical parameters for the specific composite, the probabilistic criterion of the composite failure and the reliability of the specific structure can be predicted. Graphical representations for the joint reliability and joint failure contours were made in two and three dimensional space for the several different sets of statistical strength parameters to illustrate the effect of parameters on reliability. Such understanding will enhance selection of fiber and matrix (which have their own statistical strength parameters) and can lead to improvements in reliability of some composite components in an aircraft structure. These reliability and failure concepts can also be used in repair problems by selecting the proper composite with the appropriate statistical parameters.

A STUDY OF THE EFFECT OF DESIGN PARAMETER VARIATION ON PREDICTED TILT-ROTOR AIRCRAFT PERFORMANCE

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There is currently little data available for trend analysis of tilt-rotor performance. This study analyzed the sensitivity of predicted tilt-rotor performance to variation in six design parameters: disk loading, tip speed, solidity, download, wing loading, and wing thickness ratio. Two mission profiles were analyzed: A combat search-and-rescue (CSAR) mission and an antisubmarine warfare (ASW) mission. A tilt-rotor preliminary design code (TR-87) was used to perform computer simulations; and data available from independent tests completed by NASA and the military were encoded in the input data checks. Results were presented as graphs of performance aspects plotted against the parameters varied. Because the study was a trend analysis, no specific conclusions were drawn; but a summary was made of the more significant results. It is hoped that the results of this project can serve as a guide to preliminary selection of design parameters for tilt-rotor configurations that would be suitable for a broad range of military and civil applications.

TRANSVERSE VIBRATIONS OF A COMPOSITE TUBE OF CIRCULAR CROSS SECTION

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Master of Science in Aeronautical Engineering - September 1989
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The transverse frequencies of vibration of laminated orthotopic cylindrical shells were studied in order to compare experimental resutls with results predicted by a by a modified Euler-Bernoulli beam theory. The structures studied had circular cross sections and were made of graphite /epoxy. Stacking sequences for the test structures were $[90,\pm 60_3, 90]$ and $[90,\pm 45_3, 90]$. The structures were tested under clamped-free boundary conditions. Testing was conducted by measuring the Frequency Response Function (FRF) of the structure after exciting it with an impulse from a model hammer. Response was measured using an accelerometer. Signal processing was done with a digital analyzer and FRFs were analyzed using modal analysis software. The experimental data were used to derive a modal model of the test structure. Analytical predictions were made by one dimensionalizing the two dimensional laminated plate theory equations of motion. Treatment of the test structures as beams was justified by investigating the equations of motion of classical shell theory and making physically reasonable assumptions.

APPLICATION OF NEURAL NETWORKS TO THE
F/A 18 ENGINE CONDITION MONITORING SYSTEM

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Neural networks were applied to the Engine Condition and Monitor System of the F/A-18 aircraft. Due to recent fleet experience with compressor blade failures in flight, neural networks were applied to three engine conditions; flameout due to compressor failures, normal operating conditions, and low oil pressure conditions. An attempt was made to predict compressor failure using the neural networks. A back propagation and back propagation/Kohonen network were successfully tested in recognizing the various conditions with data previously unseen by the networks. Both networks demonstrated promise in predicting failures although not enough data was available for conclusive results.

FLOWFIELD MEASUREMENTS IN THE WAKE OF
A MISSILE AT HIGH ANGLE OF ATTACK

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The flowfield about a vertically launched surface to air missile model an angle of attack of 50 degrees and a Reynolds number of 1.1×10^5 was investigated in low speed wind tunnel at the Naval Postgraduate School. Determined were the location and intensity of the asymmetric vortices in the wake of the model using planar velocity vector, total pressure coefficient, and vorticity plots. Two model configurations were tested: one at a roll angle of 0 degrees (the "+" configuration) and the other at a roll angle of 45 degrees (the "x" configuration). Two flowfield conditions were used: one with no turbulence and the other with turbulence of a length scale on the order of the size of the nose generated vortices. The following conclusions were reached: 1) the addition of turbulence changed the magnitudes of the variables without changing the patterns in the plots; 2) changing roll angle significantly altered the patterns of the plots; 3) in general, the locations of the vortices as indicated by the velocity plots do not coincide with the centers for the pressure or vorticity plots; 4) total pressure losses coincide with changes in magnitude of side force as noted in an earlier study.

DETERMINATION OF THE VELOCITY, DENSITY, MASS FLUX AND ENTHALPY PROFILES FOR VERY HIGH TEMPERATURE ARC JET NOZZLE FLOW

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Hypervelocity flows for velocities in excess of 1.4 km/sec (Mach 5) require very high stagnation temperature to avoid liquefaction. The arc heater wind tunnel has been designed to provide such flows. The electric-arc driven wind tunnel can develop stagnation temperatures up to 13,000 degrees K which will produce hypervelocity flows up to 7km/sec (earth orbital speed). The nature of the flow, however, is such that the high temperature source flow may cause severe gradients at the nozzle exit. In order to perform aero-thermodynamic tests the characterization of the flow in the test section is required. A flat velocity profile in the radial direction is necessary in order to accommodate large-scale testbodies. In addition, a flat velocity profile allows one to apply existing 2-dimensional (or 3-D) analysis to compare experiment and theory for computational fluid dynamic (CFD) code validation. This paper experimentally determines the stream profiles for an arc jet wind tunnel nozzle where the enthalpy of the stream varies from 5-15MJ/kg (6,000-13,000%K). The real gas nature of the flow requires a procedure to find velocity directly since the gas properties (e.g.y) vary across the stream. A method for accomplishing this by using calorimetry and pitot probe surveys is derived and experimental measurements are shown.

AERODYNAMIC ANALYSIS OF A U.S. NAVY AND MARINE CORPS UNMANNED AIR VEHICLE

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An aerodynamic analysis was performed on a U.S. Navy and Marine Corps Unmanned Air Vehicle (UAV) called PIONEER. A low-order panel method called PMARC (Panel Method Ames Research Center) was used to obtain various aerodynamic parameters and to evaluate the longitudinal and directional stability and control of the vehicle. In addition, a drag analysis of the vehicle was performed using techniques described in Fluid Dynamic Drag by Hoerner. Drag reduction methods were also investigated. The neutral point of the large tail PIONEER was calculated to be at 74% of the mean aerodynamic chord (MAC). The small tail neural point was calculated to be at the 51% MAC position. Cross winds limitations were obtained for PIONEER. The maximum sideslip angles due to cross wind were determined to be 8.5% and 18%. For an approach speed of 65 knots, cross wind limits were calculated to be ten knots and 22 knots for the single rudder and dual rudder cases, respectively. Drag polars were plotted for PIONEER. It was determined that drag on the vehicle could be reduced by 29% using simple cost effective modifications to be the vehicle. Follow-on analysis of PIONEER through the Naval Postgraduate School UAV Flight Test Research Program and through full-scale wind tunnel testing at the National Full-Scale Aerodynamics Complex were also discussed.

COMPUTATIONAL INVESTIGATION OF INCOMPRESSIBLE FLOWS AT HIGH ANGLES OF ATTACK

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Cebeci's viscous/inviscid interaction program was applied to the analysis of steady, two dimensional, incompressible flow past four airfoils, the NACA 663-018, 0010 (Modified) 4412 and the Wortmann FX63-137. Detailed comparisons with the available experimental results show that the essential features are correctly modelled, but that significant discrepancies are found in regions of flow separations.

AN APPROACH FOR DESIGN AND ANALYSIS OF COMPOSITE ROTOR BLADES

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The advent of tilt rotor technology asks for rotors that have different twist and RMP requirements in hover and in forward flight to optimize for operational conditions. In order to get an assessment of the capabilities to fulfill these requirements, this report present a mapping of twist angle variation as a function of RPM and laminate orientation. The basis laminate for the six models as well the D-shape spar that represents the structurally active part of the blade is assumed to be constant (0*/90*/ 0*/90*/90*/0*). This six layer cross ply laminate is chosen as it provides the necessary extension twist coupling without a hydrothermally induced twist that is highly undesirable. The couplings and trends in the models are visualized in carpet plots, one for each model, in an attempt to establish a method to answer the basic question of the magnitude of twist angle available due to a particular geometry, material and load system.

METALLIZED FUEL PARTICLE SIZE
STUDY IN A SOLID FUEL RAMJET

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Particle size measurements were obtained at the grain exit and nozzle entrance in a solid fuel ramjet combustor using a boron based fuel. The particle size distributions at the aft end of the fuel grain were generally quadra-modal, with mode peaks at 2, 4, 15, and 25-45 microns. At the nozzle entrance the distributions were tri-modal, due to the complete oxidation of the 2 micron particles. D 3,2 and the size of largest agglomerates increased with increasing equivalence ratio (or grain length), indicating that the longer grains results in more surface agglomeration. Combustion efficiency increased with equivalence ration. A direct correlation of particle size alone with combustion efficiency was not obvious and may require an accurate measurement of particle concentration.

FLOW VISUALIZATION OF THE EFFECT OF PITCH RATE ON THE
VORTEX DEVELOPMENT ON THE F-18 AIRCRAFT GTHESIS

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Experiments were performed in a water tunnel to visualize the vortex bursting phenomena on 1/48 percent scale model of the F-18 fighter aircraft. Photographs were taken to investigate the effect of three parameters on vortex bursting, i.e., angle of attack, angle of yaw, and aircraft pitch rate. It was found that the vortex burst point moves upstream with increasing pitch rate. At the same rate, vortex bursting was usually found to occur earlier for the pitch-down than for the pitch-up maneuver. Aircraft yawing generated significant vortex asymmetrics due to earlier vortex bursting on the leeward side thus leading to undesirable side forces and yawing moments.

BOUNDARY LAYER RESPONSE TO AN UNSTEADY TURBULENT ENVIRONMENT

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An Experimental investigation of a wind boundary layer subjected to periodic turbulent flow at a Reynolds number of 500,000 was conducted. Non-thrusting turbulence pulses were generated at a rate of 50 pulses per second with a turbulence intensity near 10% by spinning a rod in the free stream flow upwind of the test airfoil. Time varying velocity measurements were made at three representative chord locations (laminar, transitional/turbulent, fully turbulent) at one angle of attack using single element hot wire anemometry. The characteristics of the boundary layer velocity profiles, turbulence intensity profiles, and velocity spectra and total spectral power were documented. The time vary-ing boundary layer response could be characterized by three flow regimes: undisturbed flow; turbulence pulse; and recovery period. The boundary layer exhibited a cyclic transition response varying from the undisturbed flow regime to the turbulence pulse regime back to the undisturbed flow regime. The turbulence pulse was found to penetrate into the entire boundary layer. The turbulence prompted laminarization of the flow during the recovery period. Laminarization apparently resulted from rapid acceleration of the near surface flow within the boundary layer and local flow acceleration following the velocity deficit of the turbulence pulse. The effects of the periodic turbulence pulse were most noticeable in the recovery period at the transitional / turbulent and fully turbulent levels and reduction in boundary layer thickness indicating a stabilizing effect of the external turbulence pulse.

APPLICATIONS OF MODERN CONTROL THEORY SYNTHESIS TO A SUPER-AUGMENTED AIRCRAFT

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The singular value Bode Plot of return difference and loop gain matrices have emerged as useful indicators of multivariable robustness. The H and H2 control theories provide a systematic multivariable feedback control system. It is shown that H control theory, using specified performance objectives and stability constraints, is effective in synthesizing a stabilizing controller for the statically unstable longitudinal dynamics of the X-29. H control synthesis also demonstrates a good ability to cope with a true multivariable design problem such as the multiple, independently controlled surfaces of a super maneuverable aircraft. However, it is also shown that the control surface deflection and control rates necessary to effect the specified performance levels exceed the performance capabilities of the X-29's actuators. A work around to the limited actuator performance is provided by penalizing the control input vector more heavily during the problem formation. This approach, while reducing the actuator performance requirements, results in a limited performance X-29.

EFFECTS OF SCALING ON THE PERFORMANCE
OF MAGNETOPLASMADYNAMIC THRUSTERS
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Masters of Science in Aeronautical Engineer - 1989
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A combined theoretical and empirical numerical model was developed which predicts the performance of continuous electrode coaxial magnetoplasmadynamic thrusters as a function of thruster dimensions, mass flow rate, and input current. This model was used to predict the effects of scaling of these thrusters. The model predicts that for scaling factors down on one half, relations can be found relating the performance of one thruster to another. The model was used to examine these relationship for four different thruster configurations over a broad range of operating currents. The thrusters examined consisted of two geometries and their half scale counter parts. A conclusion from the analysis is that scaling down the size of the thruster by 50% can reduce the totaal power input by 30% to 40% comparable efficiencies. However, this is at the cost of increasing the specific impulse by a factor of two which may render the thruster inappropriate for the intended missions.

AN INVESTIGATION INTO THE USE OF AN EXISTING SHOCK
TUBE AS A DRIVER FOR A HYPERSONIC SHOCK TUNNEL
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Experiments were carried out using an existing tube alone, and with the tube connected to a two dimensional wedge nozzle. The range of maximum duration of steady reflected pressure from 3.5 to 5 milliseconds was achieved through tailored operation for incident shock strength of 3.4 and 2.0, using pure Helium and 70% Helium/30% Nitrogen mixture as the driver gas respectfully. Spark and continuous light shadowgraph technique were attempted using an optical window on the Mach 4.3 location. Results demonstrated that the short duration flow phenomena in a shock tunnel can be recorded successfully using existing equipment. Calculations showed that the addition of a Mach 10 nozzle and 15 m3 (6' diameter x 15') dump chamber would provide a useful hypersonic facility for instruction and research.

FEASIBILITY STUDY FOR ENHANCED LATERAL
CONTROL OF THE P-3C AIRCRAFT
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New mission requirements dictate the need to improve the P-3's defensive maneuvering capabilities. Research was conducted to find viable methods of increasing the current roll response of the P-3. First, a flight simulator was utilized to determine an initial "target" roll response. Next, a computer code was used to evaluate the aerodynamic effect of varying the size and defection of the aileron. These results, along with the flight simulator tests, were used to analyze the requirements to reach the target response. Several ways to achieve this goal are discussed. It was found that by increasing the aileron deflection from $\pm 20^*$ to $\pm 25^*$ and increasing the aileron chord by 50%, a 58% increase in C, could be realized. This does not reach the goal of a 100% increase in C, but it does yield a large increase in lateral control response. An increase in aileron size and deflection would certainly approach the desired goal.

INVESTIGATION OF INCOMPRESSIBLE CASCADE FLOWS
USING A VISCOUS/INVISCID INTERACTIVE CODE
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A two dimensional, incompressible viscous invicid interaction computer code, designed to compute cascade flows, was investigated. Comparison of the flow characteristics predicted by the code with experimentally available data indicates that the code predicts reasonable well flow parameters on lightly loaded cascades. However, the code fails to predict correctly the actual boundary layer development and the velocity distribution for highly loaded cascades. It is concluded that further improvement of the code is needed and recommendations are presented to achieve the required improvements.

AN EXPERIMENTAL INVESTIGATION OF SUPPORT STRUT INTERFERENCE
ON A THREE-PERCENT FIGHTER MODEL AT HIGH ANGLES OF ATTACK
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A low-speed wind-tunnel investigation was conducted to examine the aerodynamic interference caused by support struts on a three percent scale model of the YF-17 lightweight fighter prototype. The study was undertaken at the request of the NASA-Ames Research Center to obtain back-ground data in support of an upcoming investigation in which a full scale F/A 18 will be mounted in the 80x120 foot wind tunnel. Force and moment measurements were made for various strut configurations using a precision six component strain gage balance. Flow visualization studies were also conducted using smoke injected upstream of the model and illuminated by a laser sheet to highlight flow phenomenon around the model. Results of the investigation indicate that only minor aerodynamic interference was caused by the strut configurations tested. Of the configurations tested, it was determined by a subjective analysis that a slight reduction in interference could be realized by attaching the forward struts to the wing tips and the aft strut to the tail hook pivot point.

DEVELOPMENT OF A FLIGHT TEST METHODOLOGY FOR A
U.S. NAVY HALF-SCALE UNMANNED AIR VEHICLE
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Master of Science in Aeronautical Engineering - March 1989
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The development of a flight test methodology for predicting the performance characteristics of a half scale Unmanned Air Vehicle (UAV) is discussed. This methodology is the first step in developing a UAV flight test program which will ultimately be used to help improve and / or validate the performance characteristics of these type of vehicles, currently being integrated into the U.S. Navy. The methodology determined powerplant characteristics through stand tests and aerodynamic characteristics through wind tunnel and flight tests. The data from these tests were used to construct power required and drag polar curves. These curves were then used to predict the basic performance characteristics of the half-scale Pioneer. The results appear reasonable for the type of aircraft tested, within the constraints of the limited instrumentation available at this stage in the program development. The next step in the program is to use this methodology to conduct further testing in order to develop a solid data base.

INITIAL FLIGHT TEST OF HALF-SCALE UNMANNED AIR VEHICLE

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Pioneer, a short range Unmanned Air Vehicle, was recently introduced into fleet operations. Due to the manner of test and evaluation of UAV's problems with the air vehicle have been identified during, rather prior to operation use and contractor testing. A flight research program has begun at the Naval Postgraduate School to use a half scale Pioneer UAV in an attempt to study the flight behavior of Pioneer. Limitation of flight endurance below original estimators has promoted to a drag analysis of the vehicle to be performed. Previously, wind tunnel work was carried out for propeller studies. The current investigation used the results of that work to complete flights for determination of a drag polar for the vehicle. A drag clean up of the original wind configuration was performed, and though the data are scattered due to the measurement techniques, trends indicate a significant reduction in drag for the new wing. Comparison of the drag data with numerical predictions shows a reasonable correlation.

MASTER OF SCIENCE
IN
APPLIED MATHEMATICS

THREE-DIMENSIONAL FRACTAL MOUNTAINS

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Master of Science in Applied Mathematics - December 1988
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H.M. Fredricksen - Department of Math

This study provides a guide to a series of systematic techniques used to create fractal mountains. The fractal mountains are created through an Interactive System for Fractal Mountains (ISFM). To create the fractal mountains in ISFM a modified midpoint displacement technique in three dimensions is used. Augmenting the midpoint displacement algorithm is a random number generator that provides randomness in the displacement so as to simulate nature. These two algorithms plus an algorithm for lighting and for shading allow the user to develop different types of fractal mountains. When creating a fractal mountain with ISFM, the user has the options of placing the location of the light source for the time of day, of determining the ruggedness or texture of the mountain and of positioning the outline for a mountain range. ISFM generates a fractal mountain or a fractal mountain range on an IRSI workstation. ISFM provides a systematic and tutorial approach to creating fractal mountains that can be easily repeated by others.

MASTER OF SCIENCE
IN
COMPUTER SCIENCE

IMPLEMENTATION OF A LANGUAGE TRANSLATOR FOR THE COMPUTER AIDED PROTOTYPING SYSTEM

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Rapid prototyping is a method of software system development that is gaining much support presently. Rapid prototyping allows the designer to quickly produce a model of a system or part of a system which the user can see and thus verify if his requirements have been met. The prototype specifications can then be efficiently converted to an accurate set of program specifications that the programmer can implement as a final working system. The computer aided prototyping system (CAPS) is a rapid prototyping system that will automate many of the processes of prototyping such as code generation of prototype modules and searching for reusable components. One of the many components of CAPS is a language translator which translates a prototype specification written in the prototype System Description Language (PSDL) into a set of Ada procedures and packages. The Ada procedures and packages, when executed in proper order, will effectively execute the prototype. This thesis demonstrates an implementation of the translator component of the CAPS. An attribute grammar tool, KODIYAK, is used to build a translator which implements the major constructs of PSDL and produces Ada code to implement PSDL operators according to their control constraints.

DESIGN AND IMPLEMENTATION OF AN OPERATIONS MODULE FOR THE ARGOS PAPERLESS SHIP SYSTEM

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The "paperless" ship is an idea which has been advocated at the highest levels in the Navy. The goal is to eliminate the enormous amount of paper required in the normal operation of a modern Naval warship. The ARGOS system under development at the Naval Postgraduate School is a prototype development. The operations functional area, including section for training, scheduling, message generation, and publication management is an important part of this development.

THE DESIGN AND IMPLEMENTATION OF A SYNTAX DIRECTED EDITOR FOR THE SPECIFICATION LANGUAGE SPEC

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The formal specification language Spec is used for writing black-box specifications for large software systems. These black-box specifications describe the interface between a system and its users, as well as internal interfaces between modules. Systems analysts use specifications written in Spec to verify the customer's requirements during the development of a software system. This thesis demonstrates the feasibility of designing and implementing a syntax directed editor for a subset of the specification language Spec. The editor is a software tool for writing Spec specifications that ensures syntactic correctness of such specifications. The syntax directed editor is created using the Synthesizer Generator, a Computer-Aided Software Engineering (CASE) tool for generating language-based editors. The specification for the editor is written in the Synthesizer Specification Language (SSL) which is based on an attribute grammar. The software tool developed in this thesis supports the Requirements Analysis phase of the software development cycle.

AN INTELLIGENT COMPUTER-AIDED INSTRUCTION SYSTEM FOR NAVAL SHIP RECOGNITION

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This thesis discusses the design and implementation of an intelligent computer-aided instruction system for Naval ship recognition. The system uses artificial-intelligence techniques to provide an interactive tutoring environment. The student's abilities for ship recognition are tested using randomly selected side-view photos. The student's response is compared to the correct ship in an expert module. If the response incorrect the features of the correct ship are compared with those of the incorrect ship to formulate a hypothesis concerning the student's misconception. Tutoring strategies are chosen based on this comparison. The system provides a recognition test, a summary review and an individual photo review. A review of recognition features for each ship is supplied during the recognition test. A final summary is generated at the end of testing.

A PICTURE-DESCRIPTOR EXTRACTION PROGRAM USING SHIP SILHOUETTES

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This research examines the practicality of automatically identifying the features of the major structures of ship silhouettes using rule-based extraction and identification techniques. The process was broken into three phases: (a) finding the silhouette boundary (b) locating the "bumps" (apparent superstructures) on a boundary, and (c) describing the bump features qualitatively using a multidimensional-features-space classification. The program for the first phase is written in C while the programs in the other two phases are written in MPROLOG and run on a Motorola 68020-based workstation. The programs accurately identified 78% of all bumps examined on six ships. The list of bump descriptions showed the key differences between two different ships of the same ship-class, indicating future programs could identify ships using the output from the programs of this thesis.

VISUALIZATION OF HIGH-RESOLUTION DIGITAL TERRAIN

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and
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Master of Science in Computer Science - June 1989
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We explore two methods for real-time generation of more realistic two and three dimensional terrain displays than what are currently available on relatively inexpensive graphics workstations. The first method involves using a high-resolution terrain elevation database. The second method involves coloring and shading the terrain with gray-scale data obtained form associated aerial photography. Both methods were implemented with a three-dimensional simulator utilizing a high-resolution digital terrain data-base that was generated from processed F-14 stereo imagery. We describe our simulator, the High-Resolution Digital Terrain Model (HRDTM), listing its capabilities and graphic features. We also present how the system performs on a high-performance graphics workstation.

ADA AS A PAEDEUTIC TOOL FOR ABSTRACT DATA TYPES

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Master of Science in Computer Science - December 1988
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This thesis discusses on the pedagogy for abstract data types (ADTs). Language features needed for teaching ADTs are listed and arguments for needing them are provided. ADTs are implemented in Ada to show the benefit of these features. Ada possesses the desired language features but the inheritance provided in Ada is limited. Ada interface considerations and ADT implementation design strategies are critical to the pedagogy for ADTs and are also discussed. Although Ada is complex and difficult to learn and it only provides limited inheritance, it is an excellent language for teaching ADTs.

POST CRASH FLIGHT ANALYSIS: VISUALIZING FLIGHT RECORDER DATA

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Previous research has produced a real-time, three dimensional, interactive moving platform simulator (MPS). The simulator utilizes Defense Mapping Agency digital terrain elevation data to generate the three dimensional terrain and runs on Silicon Graphics, Inc. IRIS 4D/70GT graphics workstations. The MPS system has been used as a basis for a variety of military applications. We present here how the MPS system was modified to be utilized as a crash investigation tool for U.S. Army aircraft mishaps. Flight recorder data form the mishap aircraft is used to graphically reconstruct the flight of the aircraft. Flight attitudes, gauge readings, switch positions. warning and advisory light indicators, and flight control inputs are displayed. The visualization of the flight recorder data greatly aids in the analysis of the causes of an aircraft mishap.

AN EXPERT SYSTEM INTERFACED WITH A DATABASE SYSTEM TO PERFORM TROUBLE SHOOTING OF AIRCRAFT CARRIER PIPING SYSTEMS

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Maintaining and troubleshooting aircraft carrier through tank piping systems is a labor intensive, operational fleet problem. There is a clear need for a useful database and expert system to aid in fault isolation and repair planning for these system. The multiple extensive piping systems of an aircraft carrier create an intimidating modelling problem for implementing in a database. The interface of an expert system to a large database to obtain improved execution speed, exploit a useful data model, reduce memory requirements, and enhance total system capability is examined and implemented. A flexible model for representing a large ship's piping systems in a database is presented.

ENHANCEMENT TO THE COMMAND AND CONTROL WORKSTATION OF THE FUTURE

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The modern tactical commander has a flood of sensory and intelligence information at his disposal. A tool is required to sort the information that is most pertinent to the decisions he must make at that time. The Command and Control Workstation of the Future (CCWF) is an interactive, near realtime system that displays multiple windows providing visualization of the terrain in both two and three dimension. The terrain is drawn with Defense Mapping Agency Digital Terrain Elevation Data using three image resolutions in order to display large areas of terrain. This study consists of enhancements to prior work on the CCWF. The focus of this effort is in two areas. One is enhancing the maintainability of the CCWF system through the use of standard software engineering techniques (i.e., modularization, descriptive labeling, etc.). The second focus is on improving the user interface of the CCWF.

ARGOS: DESIGN AND DEVELOPMENT OF OBJECT-ORIENTED, EVENT-DRIVEN MULTI-MEDIA DATA BASE TECHNOLOGY IN SUPPORT OF THE PAPERLESS SHIP

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Argos is a prototype multimedia database developed as both a Battle Group Commander's assessment tool and the shipboard data management tool. The current prototype developed by using HyperCard /Macintosh demonstrates an effective utilization of-off-the shelf technology to solve real world problems commonly faced by the United States Navy. The ultimate goal of Argos is to provide database support for the "Paperless Ship."

A GRAPHICS WORKSTATION FIELD ARTILLERY FORWARD OBSERVER SIMULATION TRAINER

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and
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B.S., United States Military Academy, 1979
Master of Science in Computer Science - June 1989
Advisor: M.J. Zyda

Today's forward observers need a low cost, realistic training system that fully prepares them for operations in any area of potential conflict. We present a graphics workstation method of training Field Artillery forward observers to call for and adjust indirect fire. Our system used the dynamics and flexibility of computer graphics to simulate mobile observers and targets operating in a three dimensional environment. We project three dimensional terrain forr Defense Mapping Agency (DMA) digital terrain elevation data. The program depicts a functionally accurate, on screen Digital Message Device, the same device forward observers use to input missions. To allow use in Field Artillery operations, we convert the DMA terrain files from geographic coordinates to the Military Grid Reference System. We describe our simulator, the Forward Observer Simulation Trainer (FOST), listing its capabilities and features.

ANALYSIS OF EXISTING ADVANCED DATA MODELS AND THEIR APPLICABILITY AS A MODEL FOR A MULTIMFDIA DATABASE MANAGEMENT SYSTEM

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The constant and fast-paced changes that are taking place in computer technology have brought forth a vast array of new applications. It is now possible to store not only standard alphanumerical data, but also graphical, voice, and sound as well. This has opened up enormous possibilities for expanding the use of these data forms. This thesis is directed at exploring those possibilities and several current research projects that are attempting to model a multimedia database system. These models will be explored in terms of both their strong and weak points. Two possible applications will be then be looked at in terms of how they could be modeled using each of these models.

MEANINGFUL REAL-TIME GRAPHICS WORKSTATION PERFORMANCE MEASUREMENTS

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and
David Howard Jennings - Lieutenant, United States Navy
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We present how graphics work-station performance is currently measured and how performance should be measured in the future. Four levels of graphics system performance measurements are low level primitives (points and lines), pictures (collections of points and lines), system (collections of pictures), and applications (collection of system). The different techniques for measuring performance vary widely depending on the hard-ware manufacturer, the software programmer, or the article author. This paper discusses performance measurements of real-time graphics application with emphasis on expressing the measurements in common terms. This thesis was a joint research project. Mark A. Fichten was responsible for the operating area database manipulation and networking. David H. Jennings was responsible for the systems overview and the graphics display specifics. The simulator development history and performance evaluation were developed jointly.

PROTOTYPING VISUAL INTERFACE FOR MAINTENANCE AND SUPPLY DATABASES

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This research examined the feasibility of providing a visual interface to Standard Army Management Information Systems at the unit level. The potential of improving the Human-Machine Interface of unit level maintenance and supply software, such as ULLS (Unit Level Logistics System), is very attractive. A prototype was implemented in GLAD (Graphics Language for Database). GLAD is a graphic object-oriented environment for databases that gives novice and sophisticated users access to both data manipulation and program development through visual interaction. This thesis provided an extension to GLAD to demonstrate the ability to couple bitmap displays to database queries.

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A CONCEPTUAL DESIGN OF A SOFTWARE BASE MANAGEMENT
SYSTEM FOR THE COMPUTER AIDED PROTOTYPING SYSTEM

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This thesis builds upon work previously done in the development of the Computer Prototyping System (CAPS) and the Prototype System Description Language (PSDL), and presents a conceptual design for the Soft-ware Base Management System (SBMS) component of CAPS. The SBMS is the most critical component of CAPS as it will coordinate the retrieval and integration of Ada software modules. A robust SBMS that enables a software system designer to successfully retrieve reusable Ada components will expedite the prototype development process and enhance designer productivity. Implementation of the conceptual design will be the basis for further work in this area. (Ada is a registered trademark of the United States Government, Ada Joint Program Office).

MICROCOMPUTER APPLICATIONS WITH PC LAN IN BATTLESHIPS

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Master of Science in Computer Science - December 1988
Advisor: U. Kodres - Department of Computer Science

This thesis explores the hardware requirements of a local area network and then constructs a multiuser software library package for Turkish Battleships. The software implementation is designed as an expandable package so that future requirements can be met. The software package consists of three major parts. These are Personnel Evaluations, Combat Information Center and Damage Control. Listings of the programs developed are presented as well as instructions for their effective use. It is concluded that a PC Local Area Network with the proper library programs is feasible for Turkish Battle Ships' computing requirements.

CASE STUDY ON RAPID SOFTWARE PROTOTYPING AND AUTOMATED SOFTWARE
GENERATION: AN INERTIAL NAVIGATION SYSTEM

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The discipline of software engineering is on the move from an "art" to an engineering science based on mathematical rules. Along this way methods of rapid prototyping and tools for automatic program generation are being developed to aid the process of software development. This thesis takes a real life example of an Inertial Navigation system and develops it according to the automation principles for computer aided software development. The techniques of rapid software prototyping are also applied to the same problem. The software prototype of the Inertial Navigation System can further be run through the Computer Aided Prototyping System (CAPS) to mechanically generate Ada software. All implementation work is done in Ada as required by DoD for all embedded weapon systems. The two approaches will be integrated for analysis.

PERFORMANCE EVALUATIONS OF A PARALLEL AND EXPANDABLE
DATABASE COMPUTER - THE MULTI-BACKEND DATABASE COMPUTER

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This study is the actual application of a performance evaluation technique know as "benchmarking" to an experimental database management system (DBMS). The specific DBMS evaluated is the Multi-backend Database System (MBDS) which is a software multiple-backend database system. The unconventional nature of a multiple-backend computer system required the development of a special performance evaluation methodology which was the topic of several related theses. A previously developed performance evaluation methodology and the computer assisted benchmarking tools developed to implement the methodology and the computer assisted benchmarking tools developed to implement the methodology had only been applied to MBDS on a very small scale and had not been used with the current set of modern MBDS hardware. The focus of this thesis is the verification of the performance claims made by the implementor of MBDS. These performance claims were, in fact validated by conducting a series of relatively large-scale bench-marking experiments in which MBDS performed, generally, as predicted by its implementor. While the results are encouraging, future benchmarking experiments need to be conducted on an even larger database to examine MBDS performance under an extreme load. This will require the development of a high-speed database loading utility program which is not the focus of this thesis. Here, we report on the test databases, test transactions and test results (which constitute of the benchmarks) used to verify the MBDS implementors claims of response-time reduction and response time invariance.

INTERNETWORKING ISSUES: BRIDGING LOCAL AREA NETWORKS
USING SYSTEMS OF COMMUNICATING MACHINE

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Advisor: G.M. Lundy - Department of Computer Science

The evolution in network communication technology has led to the need to interconnect individual computer networks. Network designers are faced with the heterogeneity of networks just as they were previously faced with the heterogeneity of computers within a single network. In interconnecting various types of networks, therefore, many issues must be considered. This thesis identifies some of these issues as they pertain to the interconnection of two IEEE standards for Local Area Networks, Carrier Sense Multiple Access with Collision Detection (CSMA/CD) and Token Ring. The thesis further discusses a major concern regarding bridging a simplified version of the CSMA/CA and Token Ring protocol using a system of communicating machines. The model employs a combination of finite state machines and variables in the specification of each machine. Communication between machines is accomplished through shared variables. The thesis is concluded by summarizing the issues related to the bridging two Local Area Networks, CSMA/CD and Token Ring, using a system of communicating machines. The advantage this model has over other formal descriptive techniques is briefly described.

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SOFTWARE ENGINEERING WITH DATABASE MANAGEMENT SYSTEMS

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Master of Science in Computer Science - March 1989
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The purpose of this thesis is to communicate a general knowledge of software engineering principles that can be applied to the development of a software system. Fundamental Software Engineering concepts are first discussed and then applied to a personnel database management system which is featured throughout the thesis. The individual tools and techniques that are used in each phase of the system development are widely known in the computer science community and each has been employed successfully in certain situations.

THE DESIGN AND IMPLEMENTATION OF A SPECIFICATION TYPE LANGUAGE TYPE CHECKER

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The purpose of this thesis is to design a type checker for the SPEC language and to investigate its implementations using an attribute grammar tool. SPEC is a formal language for writing black-box specifications for large software systems. The type checker is a software tool which verifies the semantic accuracy of the declarations and their uses in a SPEC source program. The design specifically addresses language features which are especially important for large software system specification such as generic parameters, name and operator overloading, subtypes, importation and inheritance. Additional discussion is provided concerning the handling of the "non-block structured" nature of the specification language. This thesis implemented two of the three aspects of type checking-name analysis and error reporting. Additionally, a definitive framework was laid for the final aspect, type consistency analysis.

COMPRESSION OF BITMAPPED GRAPHIC DATA

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This paper explores the general topic of data compression, with emphasis on application of the techniques to graphic bitmapped data. Run-Length encoding statistical encoding (including Huffman codes), and relative encoding are examined and evaluated. A compression application of the Huffman coding of a run-length encoded file is designed and partially implemented in Chapter VII. A listing of the computer program which performs the compression is included as an appendix. Possibilities for further study are suggested.

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OPTIMAL THREE-DIMENSIONAL PATH PLANNING
USING VISIBILITY CONSTRAINTS
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We present an algorithm for finding optimal three-dimensional paths above polyhedral models of terrain. Airspace is modeled as irregularly-shaped region of homogeneous probability of detection, with respect to one or more fixed observers. We plan paths by first finding an optimal set of contiguous visibility regions, then an optimal piecewise-linear flight path through this envelope, using Snell's Law to find locally optimal maneuver points. The performance of our region finding algorithm favorably compares with an alternate approach using regular cubic regions.

A SPECIFICATION OF A CSMA/CD PROTOCOL
USING SYSTEMS OF COMMUNICATING MACHINES
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This thesis gives a specification of communication protocol known as "Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Medium Access Control and Physical Layer Specifications using Systems of Communicating Machines and shared variables. This protocol is defined in the ANSI IEEE Standard 802.3 (using the same name). Specification has been analysed using a method called system state analysis. The analysis showed the protocol to be free from deadlocks. This study concludes that CSMA /CD protocol needs a better specification method.

A STATIC SCHEDULER FOR CRITICAL CONSTRAINTS
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The Computer Aided Prototyping System (CPAS) and the Prototype System Description Language (PSDL) represent a pioneering effort in the field of software development. The implementation of CAPS will enable software engineers to automatically validate design specifications and functional requirements early in the design of a software system through the development and execution of a prototype of the system under construction. Execution of the prototype is controlled by an Execution Support System (ESS) within the framework of CAPS. One of the critical elements of the ESS is the static Scheduler which extracts critical timing constraints and precedence information about operators form the PSDL source that describes the prototype. The Static Scheduler then uses this information to determine whether a feasible schedule can be built, and if it can, constructs constructs the schedule for operator execution within the prototype.

PERSISTENT SEARCH: A BRIDGE BETWEEN DEPTH-FIRST AND BREADTH-FIRST FOR PHYSICAL AGENTS

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Current search algorithms and heuristics perform very poorly in the highly realistic scenario of a physical agent traversing and initially unknown search space. They don't attempt to minimize the amount of movement required by the physical agent attempting to reach a desired goal location. In order to overcome the failings of these algorithms in dealing with searchers of this particular nature, a new algorithm called "persistent search" was created. Persistent search differs from most other algorithms because it focuses on minimizing the physical movement of an active agent traversing an unknown search space, coping with the physical aspects of the problem which are too often ignored. Persistent search uses several standard techniques, but applies them in such a way as to change the semantics of the search. An interesting additional property of this algorithm is that through the manipulations of a single control variable, termed the persistence factor, the operation of the basic algorithm can be changed to span the continuum of behaviors between depth-first and breadth-first search.

DATABASE CREATION AND/OR REORGANIZATION OVER MULTIPLE DATABASE BACKENDS

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To create a record in a database one uses the INSERT command. However, in the Multi-Backend Database System (MBDS), the insert command only inserts one record at a time. When creating a very large databases consisting of thousands or millions of records, the use of the INSERT command is a time-consuming process. Once a database is created, some of the records of the database may be tagged for deletion. MBDS uses the DELETE command to tag these records. Over some period of time, those records tagged for deletion should be physically removed from the database. Hence, removing tagged records is in essence creating new databases from untagged records. In this thesis, we present a methodology to efficiently create very large databases in gigabytes on a parallel computers and to reorganize them when they have been tagged for deletion. We design a utility program to by pass the system's INSERT command, to load the database directly to disks to create all necessary base data of the database.

INTEGRATED SUPPORT FOR THE MANIPULATION AND DISPLAY OF 3D OBJECTS FOR THE COMMAND AND CONTROL WORKSTATION OF THE FUTURE

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The Command and Control Workstation of the Future (CCWF) demands a variety of platforms in various configurations to accurately reflect the environment it is attempting to portray. Prior to this research, individual platforms for the CCWF and other simulations at NPS have been coded directly into each individual program, with no commonality of design or ability to readily share or modify individual platforms. The goal of this research is to develop a text-based file format for the description, modification and display of 3D objects in the CCWF and other simulations. The other primary goals of this research are the development of interactive, graphical routines to display, view, modify and then save current objects into new files; to permit conversion of text object files to binary format for compressed storage; and to develop routines that enable the CCWF and other simulations to import objects from libraries of such 3D files directly into their programs, and display them.

A COMPUTER SIMULATION STUDY OF A SENSOR-BASED HEURISTIC NAVIGATION FOR THREE-DIMENSIONAL ROUGH TERRAIN WITH OBSTACLES

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A search strategy for autonomous vehicle navigation over three-dimensional digitized terrain containing obstacles is presented and studied in this thesis. The vehicle possesses no prior information about terrain. Using only information obtained through a sensor which has a limited sensing range, the vehicle navi-gates a goal utilizing heuristics adopted from human behavior. Simulation results produce a near-optimal path solution in a very short time. Simulation results also prove that this strategy is suitable for real-time navigation under dynamically changing or unknown environments.

DESIGN OF A SYNTAX DIRECTED EDITOR FOR PSDL

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Computer Aided Prototyping System (CAPS) is a programming tool which uses PSDL (Prototype System Design Language) as a specification language for large ADA program development. The CAPS uses a syntax directed editor as a part of the user interface for the system. This thesis focuses on the specification and design of the syntax directed editor for PSDL using the Cornell Synthesizer Generator to create a language based editor.

CODE OPTIMIZATION AND HIERARCHICAL SCHEDULING TECHNIQUES FOR IMPLEMENTING THE COMMANDER PATROL WING TEN, MOFFETT FIELD, CA (COMPATWING TEN) TRAINING ON MICROCOMPUTERS

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This research examine the practicality of using microcomputers and heuristic search techniques to handle scheduling problems. A program was developed using a hierarchical approach to produce an Annual Training Schedule for Commander Patrol Wind Ten, which includes the ready-alerts and six major inspections completed by each of the seven squadrons prior to deployments. The scheduling process is broken into three major phases: a) Initialize the program database, b) Determine the optimal month to schedule each inspection, and c) Determine the optimal sequence of days within the month to schedule each inspection. The program is written in the language M-Prolog and runs on a Motorola 68020-based work-station. Comparisons made between the manually produced and the computer generated schedules using data for two different years show that a microcomputer is capable of producing a more optimal schedule in much less time.

THE REAL-TIME ROLL-BACK AND RECOVERY
OF TRANSACTIONS IN DATABASE SYSTEM

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A modern database transaction may involve a long series of updates, deletions, and insertions of data and a complex mix of these primary database operations. Due to its length and complexity, the transaction requires back-up and recovery procedures. The back-up procedure allows the user to either commit or abort a lengthy and complex transaction without compromising the integrity of the data. The recovery procedure allows the system to maintain the data integrity during the execution of a transaction should the transaction be interrupted by the system. With both the back-up and recovery procedures, the modern database system will be able to provide consistent data throughout the life span of a database without ever corrupting either its data values or its data types. However, the implementation of back-up and recovery procedures in a database system is a difficult and involved effort since it effects the base as well as meta data database. Further, it affects the state of the database system. This thesis is mainly focused on the design trade-offs and issues of implementing an effective and efficient mechanism for back-up and recovery in the multimodel, multilingual, and multibackend database system.

DESIGN AND IMPLEMENTATION OF AN EXPERT USER INTERFACE
FOR THE COMPUTER AIDED PROTOTYPING SYSTEM

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This thesis builds on previous work done in the development of the Computer Aided Prototyping System (CAPS) and the Prototype System Description Language (PSDL). The increases in the size and complexity of software projects have caused system designers to reevaluate traditional software engineering methodologies. Rapid prototyping is a method that allows the validation of system requirements and design early in the development cycle. The need for this type of tool is particularly critical in the development of real-time embedded system. CAPS is one such system. CAPS is a complex system that consists of many individual software tools. An expert user interface that guides the software designers through the development and execution of prototype is described in this thesis.

MANAGING SOUND IN A RELATIONAL MULTIMEDIA DATABASE SYSTEM

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Sound, in all of its varied forms, is an important and widely used medium for the transmission of information. The widespread of use of computers has greatly increased the breadth and depth of our information processing abilities. Yet the limited sensory functionality of computers has traditionally dictated a predominantly alphanumeric or "textual" communications interface standard. This thesis concentrates on the effective manipulation (i.e. capture, storage, and retrieval) of sound data in a relational database system. It introduces the concept of an abstract datatype SOUND which permits a level of sophistication in data manipulations that is beyond the capabilities of current systems. Such sophistication is accomplished through the use of a set of data manipulation operations which effectively hide the representation of the SOUND data structure from the user. As a result, the current familiarity of the user's view of the database remains unchanged when extended to the multimedia information processing environment.

A PROPOSAL FOR A COMPUTER NETWORK FOR THE
INDONESIAN AIRFORCE'S REMOTE SITE RADAR SYSTEM

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The Remote Site Radar System used by the Indonesian Air Force presently used voice as its sole means of communication. A data communication network which will help store, manipulate and share data in efficient manner is needed. This thesis proposes two alternatives for a preliminary design of a computer network to support this need. It suggests how existing communication resources such as telephones, microwave links and satellite systems can be used to support the network. The first design, called Terrestrial Microwave Radar Data Link, is based on a terrestrial microwave relay. The alternative design, called Fully Connected Satellite Radar Data Link, is based on a satellite microwave relay. Both designs are analyzed as to their security. reliability and economic impact.

AN AUTONOMOUS PLATFORM SIMULATOR (APS)

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and
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Master of Science in Computer Science - June 1989
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The development of an intelligent autonomous vehicle that can perform high risk missions or operate in environment too hazardous for humans has been a long standing quest of the military community. The Autonomous Platform Simulator (APS) uses the flexibility and power of realistic graphical simulation to provide a low cost test-bed for the study of real time path planning algorithms and control strategies without the commitment of resources involved in building a prototype system. It is a bridge between the theoretical study of an abstract AI path planning problem and applied research, producing concrete performance measurements under realistic conditions. APS consists of one or more vehicle simulators, each implemented on a Silicon Graphics IRIS/4D-70GT graphics workstation. One vehicle simulator is linked with an AI agent path planner, implemented on a pair of Symbolics AI workstations using the Automated Reasoning Tool Development shell. System trails demonstrated that APS was able to achieve real time path planning and guidance of a realistically depicted ground vehicle navigating using digitized data of actual terrain. Communications bottlenecks currently limit the ability to make direct comparisons between human and machine control, but the system holds promise to fill the gap as a pre-prototype autonomous platform simulator.

THE MOVING PLATFORM SIMULATOR II: A NETWORKED REAL-TIME VISUAL SIMULATOR WITH DISTRIBUTED PROCESSING AND LINE-OF-SIGHT DISPLAYS

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and
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Master of Science in Computer Science - June 1989
Advisor: M.J. Zyda - Department of Computer Science

Previous research has produced a real-time Moving Platform Simulator using Defense Mapping Agency digital terrain evaluation data and a Silicon Graphics, Inc. IRIS 4D/70GT graphics workstation. This study is a continuation of that effort with the multiple goals of investigating the effects on simulator performance of using higher resolution terrain and different terrain drawing algorithms. Also investigated was the integration of real-time, actual platform data, electronically gathered by position location reporting instruments and platform intervisibility determinations into the simulator. Included in this effort was a study of modeling time and real world coordinate system. Additional work was performed on using a distributed computing architecture to maximize simulator performance.

A PROGRAM INTERFACE PROTOTYPE FOR A MULTIMEDIA DATABASE INCORPORATING IMAGES

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This thesis represents one aspect of an exploration of the integration of unformatted data types, such as signal, with more conventional formatted types in a single database. The focus of this thesis is the implementation of a prototype of a database employing a relational model that incorporates both formatted and unformatted datatype. Initial research was limited to integration of image data. The prototype provides storage and retrieval capabilities, as well as a modest query-handling capability.

A GRAPHICAL EDITOR FOR THE COMPUTER AIDED PROTOTYPING SYSTEM

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Master of Science in Computer Science - December 1988
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The Computer Aided Prototyping System (CAPS) is used to develop executable prototypes of large embedded software system with hard real-time requirements. The system is based upon the Prototype System Description Language (PSDL) and a set of integrated software development tools. A graphical tool is needed to decompose the PSDL composite operator into a network which shows its component parts and their communications paths. The graphical description is part of the specification of the intended system's components. This thesis explores the requirements of such an editor and demonstrates that it can be developed. It shows that the editor can effectively be used to decompose operators and that it can produce an equivalent textual representation in PSDL.

COMMUNICATIONS-EQUIPMENT DISTRIBUTION
PLANNING USING SEARCH TECHNIQUES

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B.S., Loyola University, 1983
Master of Science in Computer Science - March 1989
Advisor: N.C. Rowe - Department of Computer Science

This research developed a prototype program to plan the distribution of communications equipment within an Army organization using artificial intelligence search strategies. The system does two separate searches: it assembles the maximum number of sets of equipment from component equipment procurement, then plans how to assign these sets to organizational units. The program was done on a Sun workstation with a Quintus Prolog compiler. Due to classification requirements, fictitious, but typical data was used to test the system. The system can find near optimal ways to modernize the communications equipment of up to ten battalionized signal units, and has been tested through the procurement of three generations of equipment. There were twenty sets of equipment to allocate to the ten units in the final test case. This program can also develop a new distribution plan if unexpected events require changes to the current plan.

A SPLIT-AND-MERGE METHOD FOR CREATING POLYGONAL HOMOGENEOUS
VEGETATION REGIONS FROM DIGITIZED TERRAIN DATA

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Master of Science in Computer Science - June 1989
Advisor: N.C. Rowe - Department of Computer Science

Providing a simplified representation of terrain characteristics has applications to optimal path planning programs using spatial reasoning. Utilizing computer vision techniques, our program creates polygonal homogeneous vegetation regions based on map vegetation data from digitized Defense Mapping Agency database. Boundary points for regions are identified from the vegetation codes in the database, and then the boundary contours of the regions are traced using a modified look left boundary tracing algorithm. Each region is then represented by a polyline comprised of line segments that meet a minimum threshold for fit using the linear least squares criterion. The segments are determined by first recursively spitting the region boundary until all segments meet the fit threshold and then merging adjacent segments that meet the threshold.

THE COMMAND AND CONTROL WORKSTATION OF THE
FUTURE: SUBSURFACE AND PERISCOPE VIEWS

Gordon Kenneth Weeks, Jr.
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B.S., United States Coast Guard Academy, 1984
and
Charles Edward Phillips, Jr.
Captain, United States Army
B.S., United States Military Academy, 1981
Master of Science in Computer Science - June 1989
Advisor: M.J. Zyda - Department of Computer Science

Today's tactical commander needs to assimilate enormous amounts of information to make reasonable decisions. Graphics displays can be a valuable tool in conveying such information in a clear and concise manner. Our vehicle for studying such displays is a project entitled the Command and Control Workstation of the Future (CCWF). In this study, we focus on the subsurface and periscope views. Our primary goal is to provide the tactical commander with an interactive, user-friendly, 3D simulation system to assist in decision making, planning, and training. The secondary goal is to provide information on real-time three dimensional graphics techniques, with an eye on meaningful graphics workstation performance measurements for such techniques.

DETERMINING THE LOCATION OF AN OBSERVER
WITH RESPECT TO AERIAL PHOTOGRAPHS

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Master of Science in Computer Science - December 1988
Advisor: N.C. Rowe - Department to Computer Science

In this study, the possibility of using a computer to detect the motion of an observer by comparing two successive aerial photographs is examined. The purpose of this study was to experiment with a technique for finding a point common to both images. The techniques presented uses only sharp boundary lines and their distribution in the images to produce the "primal sketched" of the image. Once the "primal sketches" are made, the original images are not referred to again. A point common to both images is identified by comparing the number of cells with strong gradient magnitudes and their distribution in 3-pixel blocks. The technique produces excellent results in analyzing simulated succession photographs, that are taken in secession by a moving observer. Compared with other work on image correlation and object identification, the technique uses fewer features (only two) in its primal sketches, and it does not need any human intervention. Possible applications are photo interpretation, high-altitude navigation, and underwater station-keeping.

AN IMPLEMENTATION OF DATA DEFINITION FACILITY
THE GRAPHICS LANGUAGE FOR DATABASE

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Advisor: C.T. Wu - Department of Computer Science

This research is an implementation of the data definition facility for the Graphic language for Database (GLAD). GLAD is a graphic-oriented database management system which is primarily concerned with ease of learning and efficiency of use. The system uses an object relationship approach to database design. Entities of the database are represented graphically as objects. With this method, users can visualize the scheme of the database and can quickly comprehend how the entities relate. Every effort has been made to design GLAD so that a new user can quickly learn to create and manipulate a database without the need of a dedicated database administer.

RUN-TIME SUPPORT FOR RAPID PROTOTYPING

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Advisor: Luqi - Department of Computer Science

The Computer Aided Prototyping Systems (CAPS) uses rapid prototyping to quickly build an executable model of the proposed system. This thesis discusses two aspects of the run-time support for CAPS. In particular, it addresses the implementation of the error reporting functions in the CAPS debugging system and of the Dynamic Scheduler.

THREE-DIMENSIONAL ROUTE PLANNING FOR A CRUISE
MISSILE FOR MINIMAL DETECTION BY OBSERVERS

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N.C. Rowe - Department of Computer Science

We present an algorithm for finding optimal three-dimensional paths above polyhedral models of terrain using a technique we refer to as "random-ray". Contiguous sequences of homogeneous airspace volumes are generated using constrains of probability of detection and aerodynamic flight models. The flight coast are calculated as in actual mission planning using time, distance, airspeed, and fuel flow. We then try semi-random directions (rays) from the starting point, turning in accordance with Snell's Law at maneuver points (points between volumes). If we ever do not enter the previously specified next volume, we make random adjustments to the ray (in, out, up, down) with respect to the center of the facet between the two volumes, until either the path will enter the correct next volume or we determine it is impossible. The performance of our random ray technique is an improvement over an earlier approach using local optimization. We have also implemented a movable display on a graphics workstation, to allow the user the ability to view the terrain and paths from any angle.

IMPLEMENTATION OF A DISTRIBUTED OBJECT-ORIENTED
DATABASE MANAGEMENT SYSTEM

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Advisor: V. Berzins - Department of Computer Science

Distributed database management systems provide for more flexible and efficient processing. Research in object-oriented database management system is revealing an abundance of additional benefits that cannot be provided by more traditional database management systems. The Naval Military Personnel Command (NMPC) is used as a case study to evaluate the requirements of transitioning from a centralized to a distributed database management system. Features and characteristics of both distributed and object-oriented data-base management systems are used to determine the appropriate configuration for different application environments. The distributed and object-oriented concepts are evaluated in detail in order to allow an organization to appropriately select the type of system to meet their needs. Transition requirements for NMPC, in particular, are identified and suggested a plan of action is presented.

IMPLEMENTATION OF A HYPERTEXT HELP SYSTEM
FOR GLAD, A GRAPHICS LANGUAGE FOR DATABASE

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This paper explores the design and implementation of a help system for a graphical user interface names GLAD (Graphics Language for Database). It examines help system design alternatives. Emphasis is on the implementation of hypertext help system for GLAD using the Windows utility GUIDANCE and the object-oriented programming language ACTOR. Discussion includes the advantages of hypertext for on-line systems.

MASTER OF SCIENCE
IN
ELECTRICAL
ENGINEERING

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

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Master of Science in Electrical Engineering - September 1989
Advisor: J.P. Powers-Department of Electrical & Computer Engineering

This thesis describes the design and implementation of token-ring fiber optic local area network (LAN) interface module. The token-ring protocol implementing the IEEE 802.5 standard is reviewed. The initial LAN electrical signal operating at 4Mbps is provided by a LAN adapter card based on the MS380 chipset developed for twisted pair copper wire. This design features analog implementations of both the input electrical circuitry of the optical transmitter and output electrical circuitry of the optical receiver. Successful LAN communications over the fiber optic link are described.

ROOT PLACEMENT WITH TRANSFER FUNCTION METHODS
(Full State Feedback)

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Master of Science in Electrical Engineering - December 1988
Advisor: G.J. Thaler-Department of Electrical & Computer Engineering

A design technique for root placement with full state feed-back using transfer functions for all pole-plant is presented. A number of examples are presented to demonstrate the procedure with this design technique when all system states are available to be measured and fedback. The design procedure presented is applicable for linear, time invariant (LTI) systems in the s-domain for continuous time. In order to get the root at desired locations by transfer function methods very high gains are required. Therefore the design procedure should place the zeros in offset locations. To obtain some guidelines for offsetting the zeros, the root movement as a function of gain, offset zero locations chosen by matrix methods to put the roots at the desired locations, and arbitrarily chosen offset zero locations are observed on numerous system examples. The obtained guidelines are applied to the all-pole plants.

DESIGNING AN AUTOMATIC CONTROL SYSTEM FOR A SUBMARINE

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Master of Science in Electrical Engineering - December 1988
Advisor: G.J. Thaler-Department of Electrical & Computer Engineering

The purpose of this thesis is to linearize given non-linear differential equations and design a complete automatic control system for the three dimensional motions of submarine. Automatic control systems are designed using a steady state decoupling scheme for vertical and horizontal motion. Both designs are simulated using the Dynamic Simulation Language (DSL) for both linear and non-linear models and compared. Cross-coupling effect between horizontal and vertical motions due to the rudder deflections is also investigated.

NEURAL NETWORKS APPLIED TO SIGNAL PROCESSING

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Master of Science in Electrical Engineering and Electrical Engineer
September 1989
Advisor: M. Tummala-Department of Electrical & Computer Engineering

The relationship between the structure of a neural network and its ability to perform non-linear mapping is analyzed. A new algorithm, called the conjugate gradient optimization methods, for calculating the weights and threshold of a neural network is presented. The performance of the conjugate gradient algorithms is then compared to the well known back-propagation method and shown to be more computationally efficient. A neural network using the conjugate gradient algorithm is then applied to three simple examples to demonstrate its signal processing capabilities. The first example illustrates the ability of the neural network to perform classification. The second compares the performance of a one step linear predictor to a neural network for a nonlinear chaotic time series. The neural network predictor is shown to provide much greater accuracy than its linear counterpart. The final application presented demonstrates the ability of a neural network to perform channel equalization for a nonminimum phase channel. Its performance is then compared to its linear equivalent.

PSEUDO-BAYESIAN STABILITY OF CSMA AND CSMA/CD LOCAL AREA NETWORKS

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Master of Science in Electrical Engineering - December 1988
Advisor: T.T. Ha-Department of Electrical & Computer Engineering

This thesis investigates the stability of the random multi-access protocols, slotted CSMA and slotted CSMA/CD, utilizing one power level and two power levels to create beneficial power capture effect. Use of more than two equally spaced power levels provides no significant improvement in the throughput achievable when realistic capture thresholds are considered. The investigation centers on a technique known as pseudo-Bayesian stability. Another task of this thesis is to stabilize multichannel slotted CSMA and slotted CSMA/CD with pseudo-Bayesian technique. The multichannel slotted CSMA and slotted CSMA/CD show a large improvement in throughput over a traditional single channel with a combined bit rate.

CONSIDERATION OF GRAVITY GRADIENT STABILIZATION FOR ORION

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B.A., University of California, Los Angeles, 1982
Master of Science in Electrical Engineering - March 1989
Advisor: H.A. Titus - Department of Electrical Engineering

Certain ORION missions may require three axis stabilization. Since ORION's physical size severely limits its onboard fuel storage capability, passive stabilization techniques warrant investigation. This paper show the development of linearized equations of motion and regions of stability with respect to gravity gradient stabilization. Gravity gradient stab-ilization by itself provides little yaw restoring torque; therefore, additional torque generating devices are necessary to augment the gravity gradient effect. Control moment gyros, reaction wheels, and magnetic torques will be investigated as to their suitability for ORION.

LOCALIZATION OF MULTIPLE BROADBAND TARGETS IN SPHERICAL COORDINATES VIA ADAPTIVE BEAMFORMING AND NON-LINEAR ESTIMATION

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Master of Science in Electrical Engineering
Master of Science in Engineering Acoustics - June 1989
Advisor: L.J. Ziomek-Department of Computer & Electrical Engineering

Computer simulation studies of two frequency domain adaptive beamforming algorithms for planar arrays are presented. The algorithms are modified complex LMS algorithms that can process an arbitrary number of harmonics. The algorithms provide estimates of the spherical coordinates (i.e., range, depression angle, and bearing angle of multiple broadband targets in both the near-field and far-field. Computer simulation results comparing the average estimation error for range, depression angle, and bearing angle as a function of the input SNR, range (near-field and far-field), and harmonic number, are presented. The "full angular coverage" capability of the algorithms were also tested.

IMPLEMENTATION AND TESTING OF A NEW 16-PSK TRANSMITTER

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Master of Science in electrical Engineering -December 1988
Advisor: D.C. Bukofzer-Department of Electrical & Computer Engineering

The work reported herein deals with the design, implementation, and testing the performance of a specific 16-PSK transmitter for use in conjunction (in future tests) with a specific direct bit detection receiver. A specific design procedure is utilized for generating set of 2^n phase shifted sinusoid with constant phase difference, each of which represents an n bit symbol. The design of the 16 PSK transmitter is extendable to the implementation of higher order M-PSK transmitter, i.t.e., M = 32, 64 etc. The procedure utilizes a shift register and associated digital devices to produce a set of square waveforms each of which is equally and successively delayed by a fixed time increment. Frequency selective filtering is then employed to convert this collection of square waves to a set of sinusoid while maintaining the time and therefore the desired phase relationship amongst members of the set. This implementation made it possible to produce an offset 16-PSK signal constellation whose members were all equal amplitude and possessed the desired phase relationship to within one tenth of a degree. The signal constellation was highly stable and displayed an average phase drift amongst its members of less than three tenths of a degree after five and one half hours of operation. Photographs of signals in the time domain and displays of signals in the frequency domain are presented in order to highlight the important features of the system's performance.

DESIGN AND SIMULATION OF A DYNAMIC POSITIONING SYSTEM FOR A U.S. COAST GUARD BUOY TENDER

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Master of Science in Electrical Engineering - September 1989
Advisor: H.A. Titus - Department of Electrical Engineering

This paper covers the design of a dynamic positioning system for the U.S. Coast Guard WLB "IRIS" class buoy Tender. The control system design is based upon optimal control theory with estimates of position and heading provided by a steady state Kalman Filter. Sea current estimates are provided by a Kalman filter predictor based upon the innovations process. The vessel and dynamic positioning system are simulated using the Dynamic Simulation Language (DSL).

AN OCEAN MEDIUM PULSE PROPAGATION MODEL BASED ON LINEAR SYSTEM THEORY AND THE WKB APPROXIMATION

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Master of Science in Engineering Acoustics
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A general, modular, pulse propagation model for under-water acoustics that is based on linear system theory for sound speed profiles as a function of depth is presented. The development and computer simulation studies examined free-space propagation problems (i.e., no boundaries) in homogeneous and inhomogeneous media using a transfer function of the ocean medium based on the WKB approximation. The two main outputs from the model are the predicted complex acoustic field as a function of frequency and spatial location and the time-domain output electrical signal from each element in a receive planar array.

AUTOMATIC MEASUREMENT OF PARTICLES FROM HOLOGRAMS TAKEN IN THE COMBUSTION CHAMBER OF A ROCKET MOTOR

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Royal Military College of Canada, 1981
Master of Science in Electrical Engineering - December 1988
Advisor: J.P. Powers-Department of Electrical & Computer Engineering

This thesis describes the procedure used for the automatic measurement of particles from hologram taken in the combustion chamber of a rocket motor while firing. It describes the investigation done on two averaging techniques used to reduce speckle noise, capturing the image focused on a spinning mylar disk and software averaging of several image frames. The spinning disk technique proved superior for this application. The Kolmogorov-Smirov two-sample test is applied to different particle samples in order to find an estimate of the number of particles required to obtain a stable distribution function. The number of particles is calculated and given. The last part of this study show real particle distributions in the form of frequency histograms.

HIGH SPEED OUTPUT INTERFACE FOR A MULTIFREQUENCY QUATERNARY PHASE SHIFT KEYING SIGNAL GENERATED ON AN INDUSTRY STANDARD COMPUTER

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Master of Science in Electrical Engineering - December 1988
Advisor: P.H. Moose-Department of Electrical & Computer Engineering

A multiple frequency quaternary phase shift keyed signal is generated using a complex Fast Fourier Transform on an industry standard personal computer and is output using direct memory access through a digital to analog converter. The output is permitted at rates of up to the maximum direct memory access rate of the computer. An assembly language program loop, direct hardware output, and high level language output are compared as alternate solutions to the problem of outputting a data stream contained in the computer primary memory.

A COMPUTER MODEL INVESTIGATION
OF A QUAD LOG-PERIODIC ARRAY
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Master of Science in Electrical Engineering - December 1988
Advisor: R.W. Adler-Department of Electrical & Computer Engineering

This thesis investigates the possibility of developing a quad log-periodic array for use in military applications over a wide range of frequencies. The investigation of a uniformly periodic quad array was conducted utilizing the Numerical Electromagnetic Code (NEC). A numerical-experimental study of a near field characteristics and far field radiation patterns for selected version of the structure helped to identify necessary performance characteristics of a successful log-periodic version of the antenna. The near field investigation provided k versus B for a Brillouin diagram (B was determined from the relative amplitude and phase of the near magnetic field created by the structure under various conditions). Far field radiation patterns provided a check on the results of the Brillouin diagram and identified the presence of end or truncation effects. The results of this study show the potential exists for designing a successful quad log-periodic antenna. Using NEC, a selected model was run in free space to obtain radiation pattern and element currents on the array. The NEC results indicate that a quad log-periodic array with a switched transmission line has desirable log-periodic characteristics and show promise for military and commercial applications.

SEA SPIKE MODELING
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Master of Science in Electrical Engineering - December 1988
Advisor: H.-M. Lee-Department of Electrical & Computer Engineering

In this thesis, a clutter voltage model for scattering from the sea surface is developed. A model for the scattering from a whitecap and a wave breaking occurrence model are combined to simulate the back scattered signal from one radar resolution cell. The simulation performed obtained the probability density function of sea clutter under different assumptions of wind velocities and wave breaking conditions. The model incorporates some measured quantities such as the mean clutter voltage and the correlation time as parameters. The probability density function depends on the parameters of this model. The obtained probability density functions do not confirm to any familiar simple density function.

THE EFFECT OF AUTOPILOT CONFIGURATION ON MISSILE RESPONSE
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B.S., University of Chattanooga, 1979
Master of Science in Electrical Engineering - March 1989
Advisor: H.A. Titus-Department of Electrical & Computer Engineering

A comparison of two different autopilot configurations and their effect on missile response is presented. The comparison included the steps taken in determining missile parameters from wind tunnel data and flight condition data. The missile parameters are coupled with two different autopilot configurations to determine any significant advantage of one configuration over the other. Pole placement is used in determining required autopilot feedback and feed forward gains. Simulations of each autopilot are conducted and the responses are compared.

AN ENGINEERING METHODOLOGY FOR IMPLEMENTING TESTING VLSI CIRCUITS

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Department of Electrical and Computer Engineering

The engineering methodology for producing a fully tested VLSI chip design layout is presented. A 16-bit correlator, NPS CORN88, that was previously designed was used as a vehicle to demonstrate this methodology. The study of the design and simulation tools, MAGIC and MOCCIM II, was the focus of the design and validation process. The design was then implemented and the chip was fabricated by MOSIS. This fabricated chip was then used to develop a testing methodology for using the digital test facilities at NPS. NPS CORN88 was the first full custom VLSI chip, designed at NPS, to be tested with the NPS digital analysis system, Tektronix DAS 9100 series tester. The capabilities and limitations of these test facilities are examined within this thesis. NPS CORN88 test results are included to demonstrate the capabilities of the digital test system. A translator, MOS2DAS, was developed to convert the MOSSIM II simulation program to the input files required by the DAS 9100 device verification software, 91DVS. Finally, a tutorial for using the digital test facilities, including the DAS 9100 and associated support equipment, is included in an appendix.

A WEIGHTED COVARIANCE APPROACH

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Generalized Least Squares is applied to the so-called Convariance Method of linear prediction of a discrete time series using data energy weighting. Viability of this approach is substantiated via observation of resolved complex exponential in noisy measurements, and development of a performance measure. Incidental to this effort, is the notion of "Collapse," concerning the gravitation of exponential in noise, and an equivalent implementation of this weighting scheme using Recursive Least Squares (RLS).

SPIN STABILIZATION OF THE ORION SATELLITE USING A THRUSTER ATTITUDE CONTROL SYSTEM WITH OPTIMAL CONTROL CONSIDERATIONS

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Advisor: H.A. Titus-Department of Electrical & Computer Engineering

The controlled system is the ORION satellite spinning about its single axis of symmetry. Hydrazine thrusters are used as the control and are modeled by ideal, constant, magnitude step functions. The system is normalized and driven from non-zero initial angular velocities of the two axes other than the spin axis to the final condition of zero. The control profiles required to do this are determined based on a desired controller duty cycle. Adaption of the duty cycle changes the ratio of the time thrusters are on (fuel use) and total time to completion of the evolution. A comparison between a single axis and a dual controller is presented. Simulation programs for the normalized system using a single axis controller simulation program, with a 100% duty cycle and a varying duty cycle, and a dual axis controller simulation program, with each controller having a duty cycle of no more than 50%, are developed. The operation of the system is optimized using a system cost function. On equation relating the controller duty cycle of the dual system to the fuel/time trade-off parameter of the system cost function is required. A nonlinear feedback control algorithms (function of attitude angle rates) is developed from iterations of the simulation, and a priori knowledge of the form of the control from optimal control theory. The numerical solution will allow system designers to incorporate a closed form state feedback control for minimum fuel/time strategies using the ORION satellite's onboard software.

IMPLEMENTATION OF A DESIGN FOR TESTABILITY STRATEGY USING THE GENESIL SILICON COMPILER

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Design for Testability (DFT) is receiving major emphasis in the VLSI design field due to increasing circuit complexity. The utility of the silicon compiler and its value to a system designer without extensive VLSI design experience is discussed. Two major techniques for DFT, Scanpath Design and Built-in Test Design, are implemented using the Genesil silicon compiler. The basic building block, the shiftable test latch, is described in random logic block form and parallel datapath form. Linear feedback shift registers used as random vector generators and signature analyzers are used in the Built-in Test design. An Automatic Test Generation (ATG) program is used to provide a measure of fault coverage for the two DFT techniques. The Appendix is a brief tutorial illustrating the use of Genesil system's shiftable test latch in its different configurations.

REAL TIME ADAPTIVE CONTROL OF AN AUTONOMOUS UNDERWATER VEHICLE (AUV)

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In this research, the problem of designing a controller for the dive maneuver of an Autonomous Underwater Vehicle (AUV) is addressed. The highly nonlinear nature of the vehicle dynamics and the requirement for fast maneuvering call for robust control techniques. In particular, Variable Structure Control (VSC) combined with Adaptive Control (AC) techniques seem to yield satisfactory performance in terms of robustness capability to adjust to different operating conditions, and speed of response. Also, linear robust techniques based on LQG and robust observers are presented to address the case when the whole state (in term of pitch rate, pitch, and depth) is not available for measurement.

SIGN OF A THREE-AXIS STABILIZED ORION SATELLITE USING AN ALL-THRUSTER ATTITUDE CONTROL SYSTEM

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An all-thruster three-axis stabilized attitude control system has been designed for the Naval Postgraduate School (NPS) satellite bus, ORION. The satellite is a cylinder, 19 inches in diameter, 35 inches in length, 250 pounds maximum mass with 32 pounds for payloads. ORION will be ejected from an extended Get-Away-Special (GAS) canister. Launch from any GAS can configured expendable booster or the space shuttle is assumed. The minimization techniques of Pontryagin have been used to derive control laws that support fuel efficient operation. A minimum line time cost function is applied in the acquisition phase to reduce rates to acceptable levels. A weighted minimum fuel-time cost function is used during the on station phase. Bang-Off-Bang control with two switching curves is employed outside of a boundary region. Inside the boundary region, four-pulse limit cycle control with time constants on the order of 100 seconds is applied. Lifetimes in the range of 4-28 months are obtained utilizing these techniques.

INEXPENSIVE GLOBAL LOCATION AND TRACKING SYSTEMS USING GEOSTATIONARY SATELLITES

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Inexpensive Global Location and Tracking Systems are currently being designed to provide the civilian market low-cost radio position determination. This paper discusses two possible designs. The first design employs 3 or 4 satellites, depending on whether altitude is known a priori, each transmitting continuous ranging signals. The user transceiver receives the ranging signals, measures the time differentials of the receipt of the signals and transfers this information to a control station via a satellite link. The control station computes the user position from this data and sends the position coordinates back to the user via another satellite link. In the second design, each user transceiver transmits a unique code to the control station via the 3 or 4 satellite links, again depending on whether the altitude is known a priori. The control station measures the time differentials of the receipt of the signals and determines the user position. This position information is then transmitted back to the user via a satellite link.

ADAPTIVE DIM POINT TARGET DETECTION AND TRACKING IN INFRARED IMAGES

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Master of Science in Electrical Engineering - December 1988
Advisor: C.W. Therrien - Department of Electrical Engineering

The thesis deals with the detection and tracking of dim point targets in infrared images. Research topics include image process modeling with adaptive two-dimensional Least Mean Square (LMS) and Recursive Least Squares (RLS) prediction filters. Target detection is performed by significance testing the prediction error residual. A pulse tracker is developed which may be adjusted to discriminate target dynamics. The methods are applicable to detection and tracking in other spectral bands.

RADAR CROSS SECTION OF A PLANAR FRACTAL TREE

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Master of Science in Electrical Engineering - March 1989
Advisor: R. Janaswamy
Department of Electrical and Computer Engineering

Electromagnetic scattering from trees and vegetation is of prime in importance in radar and remote sensing. The actual problem of scattering from trees is rather complicated and involves three dimensional scattering from lossy, electrically large, and randomly oriented objects. In this thesis, the radar cross section of a planar fractal tree is considered. Although a planar tree is far from being real, scattering from it sheds light on the scattering phenomenon from an actual tree. The planar tree is generated using fractal geometry and its branches are considered perfectly conducting. The tree is illuminated by a plane wave and the problem is solved using the moment method. Data is presented for the radar cross section for different branching angles of the tree and at different frequencies.

AN INVESTIGATION OF NEAR FIELDS FOR HF SHIPBOARD ANTENNAS SURFACE PATCH AND WIRE GRID MODELING USING NUMERICAL ELECTROMAGNEITICS CODE

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The Numerical Electromagnetics Code (NEC) was used to evaluate the admittance, average power gain, and the electric near and far field of a monopole antenna mounted on a cubical box over a perfectly conducting ground plane. Two models of the box, employing surface patches and wire grids, were evaluated. The monopole was positioned at the center, the edge, and at a corner of the box's top surface. Admittance and average power gain of the antenna were calculated. NEC results were examined and compared with experimental data and with results from "PATCH," another independent electromagnetic modeling code. The near electric field was calculated for both models. Computer graphics techniques were presented for plotting NEC near field results using DISSPLA (Display Integrated Software System and Plotting Language), a commercial graphics package. Contour and 3-D amplitude and phase plots of the near electric fields were presented. Radiation patterns were calculated to relate far field and near field behavior of the antenna. Surface paths and wire grid models are compared and conclusions were presented.

MEASURED EFFECTS OF REPEATER JAMMING ON DIRECT-SEQUENCE SPREAD SPECTRUM RECEIVERS THAT USE ENVELOPE DETECTORS

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The effects of repeater jamming on a direct sequence spread communications system that uses an envelope detector were experimentally determined. A friendly signal transmitter, jamming signal transmitter, noiseless channel, and receiver were designed, built, and tested. The spreading sequences of the friendly and jamming transmitter modulated a carrier to create an on-off keyed (OOK) signal. The OOK signal from the jammer was delayed and added to the friendly signal. The delays ranged from to 4 chips, and the J/S ratios ranged from -20 to 20dB. This signal was then envelope detected and correlated with a replica of the spreading sequence of the transmitters. The results of the correlation show that in instances of high jamming and low jamming, reliable communication should occur. In cases where the jammer power and friendly signal power are nearly equal, the output of the correlator will not produce a signal that allows for correct tracking and therefore will not provide reliable communication.

FIXED INTERVAL SMOOTHING ALGORITHMS FOR AN EXTENDED KALMAN FILTER FOR OVER-THE HORIZON SHIP TRACKING

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The performance of an extended Kalman filter used to track a maneuvering surface target using HFDF lines of bearing is substantially improved by implementing a fixed interval smoothing algorithm and maneuver detection method that used a noise variance estimator process. This tracking routine is designed and implemented in a computer program developed for this thesis. The Hall noise model is used to accurately evaluate the performance of the tracking algorithms in a noisy environment. Several tracking scenarios are simulated and analyzed. The application of the Kalman tracker to a topical storm tracking problem is investigated. Actual storm tracks obtained form the Joint Typhoon Warning Center in Guam, Mariana Islands are used for this research.

IMPLEMENTATION OF MULTI-FREQUENCY MODULATION ON AN INDUSTRY STANDARD COMPUTER

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This report discusses the theory design, and implementation and testing of a personal computer-based Multi-Frequency Modulation (MFM) packet communications system. Transmitter/receiver programs provide software drivers for D/A and A/D boards and perform symbol encoding, modulating, demodulating, and decoding. The design and construction of a polarity coincidence correlator for receiver packet synchronization is presented. Experimental results show that the implemented MFM communication system conforms to theoretical analysis with acceptable bit error. Results show that MFM can be uniquely adapted to a specific channel.

SHIP'S ATTITUDE ESTIMATION

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Landing aircraft on board carriers is most delicate phase of flight operations at sea. The ability to predict the air-craft's carrier's motion over an interval of several seconds within reasonable error bounds may allow improvement in touch-down dispersion and a more certain value for a ramp clearance due to a smoother aircraft trajectory. Also improved information to the Landing Signal Officer should decrease the number of waveoff's. This work indicates and shows graphically that, based on the data for pitch, heave and roll measured for various ships and sea conditions, the motion can be predicted well. The predictor was designed on the basis of Kalman's optimum filtering theory for the discrete time case, adapted for real-time digital computer operations.

DOA ESTIMATION BY EIGENDECOMPOSITION USING SINGLE VECTOR LANCZOS ALGORITHM

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Subspace methods of solving spectral estimation and direction of arrival (DOA) problems involve finding the eigenvalues and eigenvectors of correlation matrices. Using the Lanczos algorithms, some of the extreme eigenvalues and eigenvectors can be approximated without requiring the entire matrix decomposition, theoretically saving many computations. This thesis develops a model and a form of the Lanczos algorithm to solve DOA problem. The relationship of the number of eigenvectors used to the accuracy of the results in a low signal to noise ratio example is examined.

ACTIVE DAMPING OF VIBRATION IN LARGE SPACE STRUCTURES USING A KARHUNEN-LOEVE REDUCED ORDER MODEL

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Large space structures are difficult to control because of the high order of their mathematical models. The high model makes the use of a reduced order model to control the structure desirable. The Karhunen-Loeve expansion along with Galerkin's method is used to generate a reduced order model. A control algorithm is achieved by applying linear quadratic regulator theory to the reduced order model. The Karhunen-Loeve basis function or mode shapes must first be found to identify the reduced order model. Previous results have shown that in the limit as the structural damping approaches zero the Karhunen-Loeve mode shapes and natural mode shapes converge. Numerical techniques are applied to evaluate the structural damping required for convergence. Once the Karhumem-Loeve mode shapes are determined, the reduced order control model is applied to the full order system. The performance of various Karhunen-Loeve models is compared by measuring the modal energies in the controlled and uncontrolled modes.

AN ADAPTIVE ARQ STRATEGY FOR PACKET SWITCHING DATA COMMUNICATION NETWORKS

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Automatic repeat request (ARQ) techniques are often used by packet switching data communication network to provide an error-free communications link between stations. The ARQ technique ensures consistent data quality under a varying link conditions. Unfortunately, the information throughout is link dependent and as the noise or interference on the link increases, the throughput decreases. In an effort to improve the throughput on a short range, RF, packet switching data communications network, an adaptive ARQ applied to Stop-and-Wait (SW) protocols strategies for different systems and link conditions was developed. Examples of information transfer between two stations using the adaptive SW protocol are presented. A simulation to compute the throughput efficiencies of the simulated adaptive SW protocol with the non-adaptive SW protocol showed good gains could be achieved using the adaptive strategy when the networks are subject to high channel bit error rates.

MODELING, SIMULATION, AND ANALYSES OF ATTITUDE CONTROL FOR THE CREW EQUIPMENT RETRIEVER (CER) PROPOSED FOR SPACE STATION

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The Crew/Equipment Retrieval System (CERS) is proposed for space station to prove the capability to rescue an EVA crewman or to retrieve equipment inadvertently detached from the station. This research is directed to model, simulate, and analyze attitude control for the Crew/Equipment Retriever (CER) with and without a target during autonomous attitude hold. Time-optimal and weighted fuel optimal control laws are derived using Pontryagin's Minimum Principle. The CER baseline configuration is analyzed to accomplish some of the attitude control trade-off analyses planned for CER preliminary design phase. Optimal thruster size and placement are evaluated for three-axis stabilization. Control stability when the moment of inertia tensor changes during target capture is evaluated for several worst case scenarios. Attitude control performance results are computed through computer simulation. Simulation of the CER baseline configuration shows it does not provide effective control during capture of a worst case 850 pound target. A new CER configuration scheme is proposed, evaluated, and compared to the baseline configuration. Fuel optimal and end of mission performance for the new CER configuration is evaluated. Simulation of the CER proposed configuration shows it provided effective control during target capture for modified locations in the capture net.

DESIGN, IMPLEMENTATION, AND TEST OF AN RS-232 COMPATIBLE BI-DIRECTIONAL, FULL DUPLEX, FIBER-OPTIC INTERFACE WITH PROVISION FOR HARDWARE HANDSHAKING ON A MINIMUM NUMBER OF FIBER-OPTIC LINES

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The objective of this thesis research was the design and implementation of an RS-232 compatible, bi-directional, full duplex, fiber optic interface with provision for hardware handshaking. Results show that active handshaking lines can be successfully multiplexed, converted to light, transmitted, received, reconverted and demultiplexed pleisichronously for data communication at 19.2 kilobaud. Use of wavelength division multiplexing and optical duplexing enabled the reduction of individual fiber optic lines required from four uni-directional single frequency fibers to two bi-directional fibers at three operating wavelengths.

DESIGN OF A RELIABLE COMPUTING SYSTEM FOR THE PETITE AMATEUR NAVY SATELLITE (PANSAT)

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This thesis proposes a processor design for the Petite Amateur Navy Satellite (PANSAT). The missions of PANSAT are considered. The design of three previous satellites with similar missions are compared. Processor functions required to support PANSAT missions are determined. Particular attention is given to the store and forward message system. A reliable processor design that implements these functions is developed. The reliability of the proposed design is examined. Minimum software requirements for the resulting design are listed.

IMPLEMENTATION OF IMAGE ACTION PLUS SOFTWARE FOR IMPROVED IMAGE ANALYSIS OF SOLID PROPELLANT COMBUSTION HOLOGRAMS

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This thesis supports computer aided data analysis of holograms produced from rocket motor firings. The work reported in this thesis modified existing software code to make it compatible with installed upgrades in the microcomputer imaging system. In particular, this involved converting the format of C language function calls to ITEX/PC image processing software to that dictated by ITEX/PC plus software. Additional modifications were performed to enhance code portability and optimization. Results indicate that all efforts to incorporate the new system software have been successful.

ERROR DETECTION AND CORRECTION FOR A MULTIPLE FREQUENCY QUATERNARY PHASE SHIFT KEYED SIGNAL

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A multiple frequency quaternary phased shift keyed (MFQPSK) signaling system has been developed and experimentally tested in a controlled environment. In order to insure that the quality of the received signal is such that information recovery is possible, error detection /correction (EDC) must be used. This thesis reviews various EDC coding schemes available and analyzes their application to the MFQPSK signal system.Hamming,Golay,BoseChaudhuriHocquenghem (BCH), Reed-Solomon (R-S) block codes as well as convolutional codes are presented and analyzed in the context of specific MFQPSK system parameters. A computer program was developed in order to compute bit error probabilities as a function of signal to noise ratio. Results demonstrate that various EDC schemes are suitable for the MFQPSK signal structure, and that significant performance improvements are possible with the use of certain error correction codes.

COMPUTATION OF MONOPOLE ANTENNA CURRENTS USING CYLINDRICAL HARMONIC EXPANSIONS

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This thesis investigates the viability of a new method for numerically computing the input impedance and the currents on simple antenna structures. This technique considers the antenna between two ground planes and uses multiregion cylindrical harmonic expansions with tangential field continuity to obtain the surface currents and input impedance. The computed results are compared to the results obtained from the Numerical Electromagnetics Code for various physical parameters to assess computational accuracy.

INFINITE IMPULSE RESPONSE NOTCH FILTER

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A pipeline technique by Loomis and Sinha has been applied to the design of recursive digital filters. Recursive digital filters operating at hitherto impossibly high rates can be designed by this technique. An alternate technique by R. Gnanasekaran allows high speed implementation using the state space structure directly. High through-put is also achieved by use of pipelined multiply add modules. The actual hardware complexity will depend upon the number of pipeline states. Theses techniques are used for the design of the IIR notch filter and finally, a comparison of the performance and complexity of these two techniques is presented.

AN EVALUATION OF COPLANAR LINE FOR APPLICATION
IN MICROWAVE INTEGRATED CIRCUIT

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A general study of conductor backed coplanar waveguide is presented. The impedance ($Z0$) and effective dielectric constant (e reff) of conductor backed coplanar waveguide (CBCPW) have been calculated by using a variational method and the boundary point matching method. In this present work, only the TEM dominant low frequency propagation mode of coplanar line has been considered. Experimental facilities are vector network analyzer (HP8409) and bench-instrument measurements.

SENSITIVITY ANALYSIS OF TRANSPUTER WORKFARM TOPOLOGIES

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Parallel processing structures as multiprocessor array and pipelining enhance throughput tremendously for suitable algorithms having high degrees of concurrency. However, if the time to process different word-packets become irregular, much of the advantage offer traditional sequential processing systems may be lost. In an attempt to produce a more flexible response to workload demand, a transputer workfarm was investigated. Two network topologies, a linear model and a tree model, were built using the transputer as the processing element (PE), or worker. An algorithms was developed which could be run independently on all workers in the workfarm. Each worker produced results independent of the other workers. By altering specific variables within the algorithm, the network performance could be changed. The results form this thesis illustrate how these parameters affect each network and provide comparative information between the linear model and the tree model.

CODE OPTIMIZATION OF SPECKILE REDUCTION ALGORITHMS
FOR IMAGE PROCESSING OF ROCKET MOTOR HOLOGRAMS

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This thesis supplements and updates previous research completed in the digital analysis of rocket motor combustion chamber holographic images. In particular, this thesis deals with the software code optimization of existing automatic data retrieval algorithms that are used to extract useful particle information form the holograms using a microcomputer based imaging system. Two forms of optimization were accomplished, the application of an optimizing FORTRAN compiler to the existing FORTRAN programs, and the complete rewrite of the programs in the C language using an optimizing compiler. The overall results achieved were a reduction in executable program size and a significant decrease in program execution speed.

ARMA MODELING

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This thesis estimates the frequency response of a network where the only data is the output obtained from an Auto-regressive moving average (ARMA) model driven by a random input. Models of random processes and existing methods for solving ARMA models are examined. The estimation is performed iteratively by using the Yule-Walker Equations in three different methods for the AR part and the Cholesky factorization for the MA part. The AR parameters are estimated initially, then MA parameters are estimated assuming that the AR parameters have been compensated for. After the estimation of each parameter set, the original time series is filtered via the inverse of the last estimate of the transfer function of an AR model or MA model, allowing better and better estimation of each model's coefficients. The iteration refers to the procedure of removing the MA or AR part from the random process in an alternating fashion allowing the creation of an almost pure AR or MA process, respectively. As the iteration continues, the estimates are improving. When the iteration reaches a point where the coefficients converge the last MA and AR model coefficients are retained as final estimates.

MODELING THE BEHAVIOR OF THE
LINEARLY TAPERED SLOT ANTENNA

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The Linearly Tapered Slot antenna (LTSA) had been investigated and developed experimentally; its applications have primarily been based on empirical designs. An accurate theoretical model based on Moment Methods (MM) is developed here to study the radiation characteristics of the LTSA. Using the MM solutions to the reaction integral equation, this thesis presents an analysis to model and explain the LTSA behavior. The effects of variable design para-meters on radiation patterns studied. Discussion is augmented by relating predicted radiation patterns to calculated current distributions on the antenna surface. Conclusions are made regarding optimum designs for the LTSA. Relevant observations are made concerning the extensive computational tasks and the computer resources required for the MM model.

COMPUTER IMPLEMENTATION AND SIMULATION OF SOME NEURAL NETWORKS USED IN PATTERN RECOGNITION AND CLASSIFICATION

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Searchers and scientists have been studying neural networks for many years hoping to achieve human-like performance in the fields of speech and pattern recognition and classification. In this study, we are going to make an introduction to the field of artificial neural networks, then we are going to describe some of the neural nets used in the pattern recognition and classification. A computer simulation program from an algorithmic approach for each one of these networks will be constructed and used to implement the operation of the net. Its ability will be demonstrated in differentiating between different patterns and even correcting a noisy pattern and recognizing it. The Hopfield network, the Hamming networks, and the Carpenter / Grossberg network will be individually utilized in developing an algorithm for pattern recognition and classification. The maximum likelihood sequence function will be mapped onto a neural network structure. The application of this structure computations for data detection in digital communications receivers will be described. A computer simulation program will be constructed and used to show that neural networks offer attractive implementation alternatives for MLSE.

DESIGN OF MULTIPLE-VALUED PROGRAMMABLE LOGIC ARRAYS

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The goal of this thesis is the development of programmable logic array (PLA) that accepts multiple-valued inputs and produces multiple valued out-puts. The PLA implemented in CMOS and multiple levels are encoded as current. It is programmed by choosing transistor geometries which control the current level at which the PLA reacts to inputs. An example of a 4-valued PLA is shown. As part of this research, a C program was written that produces a PLA layout.

DESIGNING FEEDBACK BY USING THE ROOT-LOCUS METHOD

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The purpose of this thesis is to find suitable ways to design feedback compensators for high order system by using Root-Locus methods. As a starting point, we will examine a motor amplidyne system and a position control system that were previously designed using Bode methods. Then we generalize the method and extend it to other systems. The final subject of this thesis is to design feedback compensators as filters by using state feedback coefficients to define zeros of the filter, then we extend this idea to build cascade filters.

MILLIMETER-WAVE FILTER DESIGN WITH SUSPENDED STRIPLINE

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The scope of this thesis is to establish design rules for the shielded form of Suspended Substrate Stripline (SSL) as a propagation medium, and also to introduce a practical model for calculation of the gap dimensions of the SSL. The results of this study show that there are available accurate and simple design formulas for the analysis and synthesis calculations of SSL transmission line parameters. It is shown that the proposed method for analysis of the gap discontinuity can be used for practical applications with accurate results.

PARAMETER PLANE ANALYSIS OF AUTOMATIC CONTROL SYSTEMS USING AN IBM COMPATIBLE MICROCOMPUTER

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A group of lesser used analog control system design techniques generally termed parameter plane methods, is program developed as part of this thesis. The coefficients of system's characteristic polynomial are determined by the plant and any added compensators. As these coefficients are varied, so too are the roots of the characteristic equation and therefore the system response in terms of bandwidth, settling time, etc. In the parameter plane method, a designer selects two parameters of a system's compensator(s). The parameters pole, or zero but can be any linear system function. One or more system characteristics dictating desired system frequency, are computer model inputs. The associated parameter values to achieve the input characteristics are output in graphical and/or tabular form.

AR MODELING OF COHERENCE IN TIME DELAY AND DOPPLER ESTIMATION

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The estimation of time delay and Doppler difference of a signal arriving at two physically separated sensors is investigated in this thesis. Usually, modified cross power spectrum coupled with Doppler compensation is used to detect a common, passive signal received at two separated sensors. Another successful approach uses the cross coherence to achieve this goal. This thesis modifies these two techniques to model the Doppler difference via an auto-regressive (AR) technique. Analytical results are derived and experimentally verified via a computer simulation. Performance at high and low signal to noise ratios (SNRs) is examined.

A CAD TOOL FOR CURRENT-MODE MULTIPLE-VALUED CMOS CIRCUITS

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The contribution of this thesis is the development of a CAD (computer aided design) tool for current mode multiple-valued logic (MVL) CMOS circuits. It is only the second known MVL CAD tool and the first CAD tool for MVL CMOS. The tool accepts a specification of the function to be realized by the user, produces a minimal or near minimal realization (if such a realization is possible), and produces a layout of a programmable logic array (PLA) integrated circuit that realizes the given function. The layout is in MAGIC format, suitable for submission to a chip manufacturer. The CAD tool also allows the user to simulate the realized function so that he / she can verify correctness of design. The CAD tool is designed also to be an analysis tool for heuristic minimization algorithms. As part of this thesis, a random function generator and statistic gathering package were developed. In the present tool, two heuristic are provided and the user can choose one or both. In the latter case, the better realization is output to the user. The CAD tool is designed to be flexible, so that future improvements can be made in the heuristic algorithms, as well as the layout generator. Thus, the tool can be used to accommodate new technologies, for example, a voltage mode CMOS PLA rather than the current mode CMOS currently implemented.

THE DESIGN AND IMPLEMENTATION OF A POSITION MEASURING SYSTEM FOR A REMOTELY CONTROL VIDEO CAMERA

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A position measuring system for a remotely controlled video camera was designed and built. The camera is intended to be used with the modified Advance Development Model of the AN/SAR-8 Infrared Search and Target Designation System (IRSTD) in use at the Naval Postgraduate School. The video data collected by the camera will be correlated with the infrared data from the IRSTD to develop a background database that will be used in the development of signal processing algorithms. The measurement system uses two Hewlett Packard HEDS-6000 incremental optical encoders, two Motorola MC68705U3 micro-processors and two digital display devices to measure and present the camera's azimuth and elevation angles to an operator at a remote location. The azimuth can be measured over $24^{\wedge}$ with a resolution of $\pm 0.137^{\wedge}$. The resolution is limited primarily by hysteresis, which is due to the backlash in the gears between the transducers and the axes on interest.

COMPUTER SIMULATION OF GOLD CODE PHASE MODIFICATION IN OCEAN ACOUSTIC TOMOGRAPHY

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This work investigates the viability of Gold Code phase modulation in acoustic tomography, a technique for large scale measurement of ocean characteristics. Maximal length sequences are currently used for modulation, requiring time division multiplexing of tomographic signals to avoid interference. The proposed alternative scheme of code division multiplexing Gold code modulated signals promises more rapid, simultaneous ocean projections.Computer simulation enables side-by-side comparison of the Gold code and maximal-length sequence modulating methods. Based on favorable results, a specific set of Gold codes is recommended for future use in a tomography experiment.

PERFORMANCE OF RADAR RECEIVERS IN THE PRESENCE OF NOISE AND INTENTIONAL INTERFERENCE

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This thesis is devoted to analyzing the problem of masking a reflected radar signal, in order to degrade the radar receiver's performance. This is to be accomplished by appropriately choosing the Power Spectral Density (PSD) of a power constrained colored noise interference to be generated either by the target itself or by prepositioned "friendly" noise makers. The goal in either case is to generate interference signals that results in decreased receiver probability of detection, P d, for a given receiver probability of false alarm, P f. Efforts to identify appropriate PSD's of the power constrained inter-ference were carried out by evaluating the receivers' P d as a function of P f for two specific target models. The performance results for the various receivers investigated demonstrate that the noise interference generated by the noise makers can achieve significant levels of degradation, while the target generated noise interference tends to improve rather than degrade the radar receiver's performance. In all cases considered, the sinc squared shaped noise interference PSD is more effective at degrading the receiver performance than any other kind of PSD analyzed.

WIRE GRID MODELING OF THE LINEARLY TAPERED SLOT ANTENNA

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The Linearly Tapered Slot Antenna (LTSA) has been the subject of considerable study and experimentation. Accurate theoretical models based on the Method of Moments (MOM) have been developed to study the radiation characteristics of this antenna. However, these models are limited due to the great amount of Central Processing Unit (CPU) time required to obtain the solution. Employing the Numerical electromagnetics Code (NEC), an accurate wiregrid model of the LTSA is developed here in order to reduce the CPU time needed to obtain the solution. Numerical results are presented for the radiation pattern and compared with experimental results of the actual planar structure to validate the model and optimize the wire-grid. Once the model has been optimized, effects of variable design parameters on radiation patterns are studied. Conclusions are made regarding optimum designs for the LTSA.

AN APPLICATION OF A KALMAN FILTER FIXED INTERVAL SMOOTHING ALGORITHM TO UNDERWATER TARGET TRACKING

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A Fortran program was developed to implement a Kalman Filter and Fixed Interval Smoothing Algorithm to optimally smooth data tracks generated by the short baseline tracking ranges at the Naval Torpedo Station, Keyport, Washington. The program is designed to run on a personal computer and requires as input a data file consisting of X, Y, and Z position coordinates in sequential order. Data files containing the filtered and smoothed estimates are generated by the program. This algorithm uses a second order linear model to predict a typical target's dynamics. The program listings are included as appendices. Several runs of the program were performed using actual range data as inputs. Results indicate that the program effectively reduces random noise, thus providing very smooth target tracks which closely follow the raw data. Tracks containing data generated in an overlap region where one array hands off the target to the next array highlighted. The effects of varying the magnitude of the excitation matrix Q(k) are also explored. This program is seen as a valuable postdata analysis tool for the current tracking range data. In addition, it can easily be modified to provide improved real time, on line tracking using the Kalman Filter portion of the algorithm alone.

A COMPARISON OF TWO FREQUENCY DOMAIN ADAPTIVE BEAMFORMING ALGORITHMS FOR SONAR SIGNAL PROCESSING

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Computer simulation studies of two frequency domain adaptive beamforming algorithms are presented. The two algorithms are the frequency domain adaptive beamforming modified least mean square algorithm, and the proposed new frequency domain adaptive beamforming algorithm based on modified adaptive linear prediction error filtering. The simulation studies were conducted to determine the multiple broadband target localization capability and the full angular coverage capability of the two algorithms. The number of iterations that the adaptive algorithms took to reach a minimum estimation error was determined. The algorithms were evaluated at several signal to noise ratios. Finally, using the results of the simulation studies a comparison between the two algorithms is performed.

AN ALGORITHM FOR SEDUCTION CHAFF IN ANTI-SHIP MISSILE DEFENSE FOR A VARIABLE AZIMUTH AND ELEVATION LAUNCHING SYSTEM

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The purpose of this work is to provide an optimum shipboard solution to defeat an incoming anti-ship missile (ASM). A computer program was implemented that will use chaff to breaklock on an ASM in the terminal guidance phase to achieve a missile softkill. The program will provide an optimal location to place chaff from a variable azimuth and range launcher and an appropriate ship maneuver to defeat the missile at maximum range. The algorithm is generic, and by changing the variables, the program can be tailored for most types of missiles, targets, or decoys. The graphics output reveals the dynamics of the missile seeker radar resolution cell and the time variant aspect of the target and decoy within the cell. By using a personal computer and graphics package, this program can be used as a visual training device for defeating an incoming missile.

IMPLEMENTATION AND EVALUATION OF A MAINFRAME DEPENDENT PROGRAM (NEC3) ON A PERSONAL COMPUTER (PC)

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Master of Science in Electrical Engineering - December 1988
Advisor: R.W. Adler-Department of Electrical & Computer Engineering

The purpose of this study was to determine if recent improvements in the computing power of Personal Computers (PCs) have made them a viable alternative to the larger multi-user oriented computers, better known as mainframes. The Numerical Electromagnetics Code (NEC3), a 10,000 line Fortran program, was down-loaded from the Naval Postgraduate School's IBM 3033AP mainframe and implemented on various PC systems. The systems considered were the IBM RT PC (using IBM RT PC VS FORTRAN), a Definn DSI-780 Coprocessor Board (using SVS FORTRAN), and a Compaq Deskpro 386/20 AT PC (using NDP FORTRAN-386). Using NEC3 example problems, comparisons of speed and accuracy were made between the PCs and the mainframe. Results show that the Compaq Deskpro 386/20, with a Weitek 1167 math coprocessor, using MicroWay's NDP FORTRAN-386 (32 bit Fortran compiler), can be used to implement NEC3 on a PC. Performance times for the Deskpro (w/1167) were only 20% to 25% slower than the main-frame's. Due to the Weitek's internal accuracy (single precision), solutions of the NEC3 examples were comparable to the mainframe's only for simple problems. As the complexity of the NEC3 problems increased, the error due to the Weitek's single precision calculations also increased. It is assumed that the reader is currently knowledgeable on the use of an IBM AT PC or compatible and that the reader is familiar with the PC's Disk Operating System (DOS).

INSTANTANEOUS POWER SPECTRUM

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March 1989
Advisor: R.D. Hippenstiel - Department of Electrical Engineering

The need for tools capable of handling non-stationarities in the spectral content of the data has been recognized as early as 1946. The Wigner-Ville Distribution (WD) has been extensively used since its introduction in 1948, but suffers from some associated problems (e.g., spectral cross-terms and requiring the use of analytic signals). An alternative Distribution is proposed, which has its origin in the definition proposed by Page of "Instantaneous Power Spectrum" (IPS). Its characteristics are examined and, when pertinent, compared to the WD. It is shown to be less sensitive to the problems afflicting the WD, but provides less frequency resolution. The usefulness of a parametric (AR) version was investigated. Tests are examined to demonstrate the performance and trade-offs of IPS.

REAL TIME IMAGE ENHANCEMENT DURING UNDERWATER RECOVERY OPERATIONS

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Master of Science in Electrical Engineering - June 1989
Advisors: C.W. Therrien & R. Cristi
Department of Electrical & Computer Engineering

The development of a menu-driven real-time image processing program is to be used during underwater torpedo recovery operations is described. Included are an analysis of the images to be processed, a description of the hardware and software tools available to solve the problem, the methodology used to select the most effective enhancement functions, and the results of a test of the program conducted in an underwater recovery environment. Appendices include a source code listing for the program and a User's Manual which provides hardware setup instructions, a tutorial on the use of the program, and a quick reference list of the menu options available.

ALGORITHMS FOR COMPUTER AIDED DESIGN OF DIGITAL FILTERS

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Master of Science in Electrical Engineering - December 1988
Advisor: R. Strum-Department of Electrical & Computer Engineering

The algorithms necessary for the computer aided design of digital filters form lowpass prototypes have been developed and compared then implemented in a computer program to aid in the instruction of digital filter design.

CHANNEL AND SWITCHBOX ROUTING USING A GREEDY BASED CHANNEL ALGORITHMS WITH OUTWARD SCANNING TECHNIQUE

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Advisor:C. Yang-Department of Electrical & Computer Engineering

The problem of channel routing and for that matter routing in general has been attacked in a heuristic manner vice analytical. This is not necessarily "wrong," however it means that there is not always a solution to the problem. Channel routing is one of the most important phases in VLSI CAD (Very Large Scale Integration Computer Aided Design). It performs the detailed routing of a given channel. The switchbox is a four sided channel area, rectangular in shape, with nets entering from all sides. There has been much work done in the channel and switchbox routing areas. The Greedy router, a proven heuristic, is one of the important building blocks for most of today's detailed routers and is used as basis for this thesis.

Most routers scan the routing area using a left to right scanning method. This thesis attempts a different variation in routing, using an outward scanning technique. The thesis demonstrates how this new algorithm can be applied to various channel routing problems, by performing tests and making comparisons. The thesis also demonstrates how this new router can be used as a CAD tool. The new router assumes that all pins and wiring lie on a common grid, and that vertical wires are on one layer, horizontal on another. The thesis also shows how this new channel router can be modified to allow for a switchbox router implementation.

THE PERFORMANCE OF CONVENTIONAL AND DBD RECEIVERS FOR MFSK/QPSK MODULATION WHEN OPERATING IN THE PRESENCE OF NOISE AND RAYLEIGH FADING

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This thesis is devoted to studying the properties of a digital M-ary signaling scheme called MFSK / QPSK which combines the features of M-ary FSK and QPSK modulation. This scheme shown to be a form of biorthogonal signaling, and a receiver that is optimum in error rate sense is introduced and analyzed in order to obtain its bit error rate (BER) performance when signal interference can be modeled as additive white Gaussian noise. The bandwidth of the MFSK/QPSK signaling scheme is derived and compared with that of M-ary PSK and M-ary FSK signaling. MFSK/QPSK signaling results in receivers that provide error rates much lower than corresponding receivers for M-ary PSK and slight lower than those for M-ary FSK, while maintaining a bandwidth efficiency at least three times greater than that of M-ary FSK through not as great as that of M-ary PSK signaling. A significant effort has been devoted to examining a detection method known as direct bit detection (DBD) which has been applied to M-ary PSK and MFSK/QPSK signaling. DBD receivers are introduced, and the BER of the MFSK / QPSK DBD receiver is derived and compared with that of the optimum (symbol discrimination) receiver. Lastly, the effects on performance due to Rayleigh fading are analyzed and evaluated for M-ary PSK DBD receivers as well as for the MFSK/QPSK optimum (symbol discrimination) and DBD receiver.

ON CAPTURE EFFECT OF FM DOMODULATORS

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Master of Science in Electrical Engineering - March 1989
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The reception of FM carriers is characterized by a capture effect whereby the message of the dominant carrier is recover-ed when tow or more FM carriers are present. This research uses a computer to form a type of average of the instantaneous frequency of the receiver input. The results establish that averaging (smoothing or lowpass filtering) of the instantaneous frequency reveals the capture effect. The effect on capture of bandwidth and amplitude ratio for the case of two carriers is revealed. The result show that capture can occur when two carriers are separated by as little as 0.17 dB in amplitude.

ADAPTIVE TWO DIMENSIONAL RLS ALGORITHMS

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Master of Science in Electrical Engineering & Electrical Engineer
March 1989
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A Two Dimensional Fast Recursive Least Squared (2-D FRLS) algorithm is presented using a geometrical formulation based on the mathematical concepts of vector space, orthogonal projection, and subspace decomposition. By appropriately ordering the 2-D data, the algorithm provides and exact least squares solution to the deterministic normal equations. The method is further extended to the general FIR Wiener filter and to ARMA modeling. The size and shape of the support region for both the MA and AR coefficients of the filter can be chosen arbitarly. The ARMA parameter estimation problem is also considered for the case when the system input is not available. Computer simulations are presented to illustrate the applications of the algorithm for 2-D parameter estimation, system identification and image coding.

PARAMETER PLANE DESIGN METHOD

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In this thesis, a control systems analysis package is developed using a parameter plane methods. It is an interactive, user-friendly computer aid to plot families of performance index cost curves. By superimposing the cost curves on the parameter plane curves, the designer is able to choose values of the parameters which provide a good compromise between cost and dynamic behavior.

TWO-DIMENSIONAL AUTOREGRESSIVE MODELING

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Linear prediction has become an important tool for stationary time series analysis. The all-pole system model which is a product of the linear predictive approach has applications in numerous engineering problems. This thesis develops a simple method for obtaining the two dimensional all pole system model. The lattice structures that can be used to implement the prediction error and synthesis filters are also shown to have an analogous two dimensional counterpart. The construction of these filters is in terms of orthogonal Szego polynomials which can be used to solve the two-dimensional block Toeplitz normal equations in a recursive manner. The recursion not only leads to the two-dimensional (2-D) lattice structure, but also allows for expansion of the filter order without resolving the normal equations. Several examples are presented using the two dimensional linear prediction results for spectral estimation and signal synthesis.

ON-ORBIT ANNEALING OF GALLIUM ARSENIDE SOLAR CELL ARRAYS

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A complete experimental package is developed for the acquisition of current voltage curves and the annealing of Gallium Arsenide solar cell and array of cells. This package is designed to be placed aboard a wide variety of satellite buses and to operate with little interface to the satellite system.

A LINEAR SYSTEMS THEORY APPROACH TO THE RANGE-INDFPENDENT ACOUSTIC CHANNEL

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Using linear systems theory as a framework, the solution for the acoustic field present in a range independent acoustic channel excited by a complex weighted, planar array of point sources with an arbitrary input electrical signal is derived. The ocean medium a characterized by a transfer function, obtainable as the solution to the Helmholtz wave equation. The transfer function for an isospeed, three-layer waveguide is derived. The unbounded homogeneous medium equations are derived as a special case of the waveguide problem. The problem of interference due to the Presence of a pressure-release surface is also derived as a special case. The linear systems approach lends itself to a modular computer implementation, in which different ocean medium models are represented by subroutines implementing their transfer functions. The equations for a group range independent medium are implemented as a group of subprograms. Results are presented for the special cases of a homogeneous medium and the surface reflection problem, which can be checked against known, easily interpreted analytical solutions. Finally, an example of waveform prediction for the isospeed, three-layer waveguide is presented.

SIMULATION OF OCEAN ACOUSTIC TOMOGRAPHY
USING MATCHED FIELD PROCESSING

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June 1989
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The feasibility of applying the principles of matched field processing to ocean acoustic tomography were studied under various conditions of ambient noise. Several likelihood estimators were examined (E.G., Bucker, Bartlett, Maximum Likelihood, etc.). Simulations were initially conducted for the simple case wherein only one parameter of the medium was unknown (e.g., SOFAR axis depth, surface sound speed, position of a single acoustic front). The method was then applied to the more realistic problem of locating the boundaries of an eddy in the ocean. For moderate signal to noise ratios, all the estimators were shown to be able to solve the problem, albeit with different efficiencies. For low single to noise ratios, the MLM scheme proved to be the most reliable especially when a highly correlated ambient noise was present. In all cases, computer simulations illustrated that mismatching may occur when the parameterization of the medium is poorly approximated. Mismatching leads to decrease in the efficiency of the estimators but it may be still possible to correctly estimate the environmental characteristics.

CIRCUIT RECOGNITION OF VLSI LAYOUTS

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The design process of a very large scale integrated (VLSI) circuit is time consuming, with design verification and timing analysis being two of the most tedious stages. The development of a computer aided design (CAD) tool that verifies circuit design and timing will reduce the design time. The primary contribution of this thesis is to provide an initial tool that will assist VLSI designers with the verification of a circuit's design. The tool is the first of several modular programs which will give the designer the capability to quickly and accurately verify a VLSI circuit design and timing. The primary goal of this thesis is to develop an algorithm that will recognize different elements within the simulation file of a Complementary Metal Oxide Silicon (CMOS) circuit. Several simulation files were obtained using Magic which is a layout editing system developed at the University of California, Berkeley. These simulation files were analyzed and a C program was written that would accomplish circuit recognition. Results demonstrate that recognition of not only transistors, inverters, and passgates is possible, but also complex elements. A section is provided that describes user for this algorithm.

SERRODYNING BY MEANS OF A DIGITAL PHASE SHIFTER

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Serrodyning operation is employed by the velocity deception ECM jammer to counter those radars utilizing a target's doppler shift information. The jammer will frequency translate an incoming signal by a desired amount and at a specified rate during retransmission. If the radar follows the ECM signal, it is left without a target in its velocity gate when the ECM signal is turned off. The operation can be accomplished by either a TWT (Travelling Wave Tube) or a DPS (Digital Phase Shifter). The purpose of this research is to determine the properties of the spectrum of sinusoidal signal which is phase modulated with a staircase wave-form. The investigations include the study of the qualities of the output spectrum and the characteristics of the operation, e.g, number of steps (phase resolution), phase accuracy, switching speed, translation loss and suppression ratio. Results are verified by simulation as well as by measurements. The translation frequency, which is constrained by the switching speed of the device, affects the serrodyning performance the most. As higher translation frequencies, bits associated with small phase resolution do not contribute significantly to the suppression effect. The carrier frequency and input power have been found to have minimal effect on the serrodyning performances. Since the bandwidth of a radar's doppler filter is narrow, near side frequencies are less desirable in terms of degrading serrodying effectiveness than those distant unwanted harmonic side frequencies, which may be of higher amplitude. The suppresion ratio with reference to the nearest undersired side frequency is in general, more than 25dB. The original carrier residue has also been suppressed by at least 25dB. A DPS is better than a TWT in implementing serrodyning in terms of spectral purity, finite flyback, ease of implementation and controllability.

AFFINE INVARIANT OBJECT RECOGNITION BY VOTING MATCH TECHNIQUES

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This thesis begins with a general survey of different model based system for object recognition. The advantage and disadvantage of those systems are discussed. A system is then selected for study because of its effective Affine invariant matching {Ref 1} characteristic. This system involved two separate phases, the modeling and the recognition. One is done off-line and the other is done on-line. A Hashing technique is implemented to achieve the fast accessing and voting. Different test data set are used in experiments to illustrate the recognition capabilities of this system. This demonstrates the capabilities of partial match, recognizing objects under similarity transformation applied to the models, and the results of noise perturbation. The testing results are discussed, and related experiences and recommendations are presented.

ADAPTIVE GO-BACK-N AN ARQ PROTOCOL FOR A TACTICAL VSAT NETWORK

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Tactical satellite networks required a Data Link for Point to point communications. It is of particular interest that the DLC protocol continues to operate under high bit error ratio conditions due to added noise caused by interference from other communications systems or intentional jamming. Automatic Repeat Request (ARQ) protocols are the most commonly used DLC protocols in commercial systems. However, under high bit error ratio conditions, the throughput efficiency of an ARQ protocol decreases rapidly. To improve the throughput efficiency of ARZ protocol, some adaptive ARQ strategies have been theoretically analyzed. One particular ARQ protocol, an adaptive Go-Back-N (GBN) protocol, was selected for implementation in a tactical satellite network. The throughput efficiency of the adaptive GBN protocol was evaluated using data produced by a computer simulation. The simulation results for a three-stage data produced by a computer simulation. The simulation results for a three-stage adaptive GBN protocol revealed a severe decrease in throughput efficiency when the bit error was sufficient to cause frequent transitioning between the second and third stages. Under increasing bit error ratio conditions, a simulation of a two-stage adaptive GBN protocol demonstrated an appreciable improvement in throughput efficiency over a standard GBN protocol and the three-stage adaptive GBN protocol.

A SYSTOLIC STRUCTURE FOR ON-LINE SYSTEM IDENTIFICATION

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In this study, we present an algorithm for system indentification for systolic array implementation. With this scheme, discrete samples of input and output data of system with uncertain characteristics are used to determine the parameters of its model. The identification algorithm is based on recursive least squares, QR decomposition, and block processing techniques with convariance resetting. The identification process is based on the use of Givens rotation. Additionally, we want to address the following problems; how the round off error propagates in time and the implementation of fixed point arithmetic with the implementation of floating point arithmetic. This is primarily a theoretical investigation to be conducted with computer simulations where numerical results will be investigated.

DEEP NULL ANTENNAS AND THEIR APPLICATIONS TO TACTICAL VHF RADIO COMMUNICATIONS

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This study examines antennas with a characteristic cardioid radiation pattern, their applications to VHF radio communications and their design, construction and performance. Structures are investigated using both the Mini-Numerical Electromagnetic Code (NCE). A test structure is built, test data obtained, and a comparison of test results versus predicted results is made.

AN EXPERIMENTAL AND COMPUTER MODELING STUDY
OF STEPPED RADIUS MONOPOLE ANTENNAS

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This thesis compares the input impedance numerically calculated by MININEC, NEC, and NECGS with experimental results on stepped radius monopole antennas for swept frequencies. This determines the limitation of computer codes and give guide-lines for Yagi and Log Periodic (LP) antenna designs which use Tapered Linear Antenna Elements (TLAE's). NEC and MININEC, thin wire modeling codes, use different Electric Field Integral Equation (EFIE) formulations of "the method of moments" for the solution of currents. A cylindrical wire cage model is used via NECGS. Four groups of computer models are developed, varying the number of segments from 1 to 70 for 27-31 MHz. Reflection coefficients of seven experimental models are measured at the antenna feed point, and the input impedances are calculated by an auxiliary computer program. The input impedance is then analyzed by comparing the computer simulation results with measured results. Surprisingly, the input impedance of MININEC is closest to experimental results for monopoles which were constructed with ratios of radius to wave-length up to 0.0026.

ANALYSIS OF MARITIME MOBILE SATELLITE COMMUNICATIONS SYSTEMS

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The communication channel between a satellite and a ship earth station (SES) is described by a model which includes multi-path fading, doppler shift and noise. Multipath fading is caused by reflections form the sea surface. These reflections can affect the system performance, especially at low elevation angles or when SES is using gain antennas. Doppler shift is a very important effect when using low altitude satellites, because of the high velocities involved. This thesis describes and presents a software simulator for multipath fading in the maritime communications environment. Analysis of throughput of an unslotted Aloha maritime mobile satellite communication channel is also presented.

MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

SPATIAL VARIABILITY OF THE AMBIENT NOISE FIELD ASSOCIATED WITH THE MARGINAL ICE ZONE AND ITS RELATIONSHIP TO ENVIRONMENTAL PARAMETERS

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During the month of July 1987, an acoustical experiment was conducted by the United States Naval Research Laboratory (NRL) in the East Greenland Sea Marginal Ice Zone (MIZ). Ambient noise "hot spots" or concentrated areas of relatively high noise levels were found along the ice edge using a towed array. Ambient noise levels were obtained on 27 and 28 July using AN/SSQ-57A and AN/SSQ-57XN5 calibrated sonobuoys. The temperature structure of the area was determined using XBT (ship) and AXBT (P3C aircraft) buoys placed inside and outside the ice edge. The ice edge was determined from coincident satellite photo, 90 GHz microwave imagery and P3 radar ice edge maps. Weather data (sea state and wind speed and direction) were recorded on the ship. The data seem to indicate a correlation between the high ambient noise levels of the hot spots and the presence of a large topographically controlled mesoscale eddy located at the southeastern extent of the MIZ.

LOCALIZATION OF MULTIPLE BROADBAND TARGETS IN SPHERICAL COORDINATES VIA ADAPTIVE BEAMFORMING AND NON-LINEAR ESTIMATION

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Electrical Engineering - June 1989
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Computer simulation studies of two frequency domain adaptive beamforming algorithms for planar arrays are presented. The algorithms are modified complex LMS adaptive algorithms that can process an arbitrary number of harmonics. The algorithms provide estimates of the spherical coordinates (i.e., range, depression angle, and bearing angle) of multiple broadband targets in both the near-field and far-field. Computer simulation results comparing the average estimation error for range, depression angle, and bearing angle as a functions of the input SNR, range (near-field and far-field), and harmonic number, are presented. The "full angular coverage" capability of the algorithms was also tested.

AN OCEAN MEDIUM PULSE PROPAGATION MODEL BASED ON LINEAR SYSTEMS THEORY AND THE WKB APPROXIMATION

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A general, modular, pulse propagation model for underwater acoustics that is based on linear systems theory for sound speed profiles as a function of depth is presented. The development and computer implementation of the model, together with results from preliminary computer simulation studies involving the transmission of CW and LFM pulses from a planar array of complex weighted point sources is reported. The studies examined free-space propagation problems (i.e., no boundaries) in homogeneous and inhomogeneous media using a transfer function of the ocean medium based on the BKB approximation. The two main outputs from the model are the predicted complex acoustic field as a function of frequency and spatial location and the time domain output electrical signal from each element in a receive planar array.

THE MEASUREMENTS OF THERMOACOUSTIC
PHENOMENA USING THERMOACOUSTIC COUPLES
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Department of Physics

Thermoacoustic heat transport and its applications, such as thermoacoustic engines and refrigerators, have been discussed in a number of articles over the past several years. However, lacking from these articles is a thorough, quantitative experimental investigation of the basic theory underlying thermoacoustic heat transport. Such an investigation is the purpose of this thesis. A logical starting point for such a study is to investigate the simplest class of thermoacoustic engine - a stack of short plates referred to as a ThermoAcoustic Couple, or TAC. The utility of this choice is that the theory can be reduced to its simplest form or analysis of the results. The results of measurements of thermoacoustically generated temperature gradients in TACs subjected to acoustic standing waves are reported. The value of the temperature gradient, which results from an acoustically generated entropy flow in the gas in thermal contact with the plate, is a function of the acoustic pressure amplitude, the mean gas pressure, the Prandtl number of the gas, the configuration of the TAC, and its position in the standing wave.

Measurements were made with a computer controlled apparatus for drive ratios (the ratio of the acoustic pressure amplitude to the mean pressure of the gas) from approximately 0.1 to 2%, in argon and helium having mean pressures from approximately 0.1 to 0.3 MPa, for three different TACs as a function of their positions in the standing waves. The results are compared with predictions based on a theory by Wheatley et al [J. Acoust. Soc. Am. 74, 153-170 (1983)]. Three distinct regions of behavior are apparent over the range of drive ratios investigated. For drive ratios less than approximately 0.4%, there is overall good agreement between thoery and measurement. For drive ratios between approximately 0.4 and 1%, the agreement diminishes almost linearly with increasing drive ratio. For drive ratios greater than approximately 1%, irregularities appear in the temperature difference data series and the discrepancy between theory and measurement generally remains approximately constant, although some variations occur.

SIGNAL PROCESSING AND PRELIMINARY RESULTS IN THE
1988 MONTEREY BAY TOMOGRAPHY EXPERIMENT
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Advisor: J.H. Miller - Department of Electrical and Computer Engineering

Ocean acoustic tomography is particularly suited to observing mesoscale dynamic processes, which may not be adequately observed by more conventional methods. Ships and buoys are limited in their sampling rates by location and/or transit speed while the tomographic signal samples the current and temperature fields all along its path at the speed of sound. Variation in the travel time of the signal occurs due to inhomogeneity in either the sound speed or the current. The oceans fluctuation can then be estimated form the travel time perturbation using mathematical inverse methods. The 1988 Monterey Bay Tomography Experiment had several specific goals: to test new technology for real-time transmission of tomographic data to shore, to examine the feasibility of doing acoustic tomography in a coastal environment, and to examine the effects of coastal ocean processes such as surface and internal waves and rough bottom on the tomography signal. This thesis concentrates on signal design using maximal-length sequences, data recording, and a fast algorithms for a data synchronous digital correlator receiver in this experiment. The new tomographic data recording system has demonstrated its effectiveness. Preliminary results of the data analysis are given, including power spectra for the arrival time perturbation series in the 0.01 to 0.26 Hz (surface wave) frequency band. These spectra correlate well with surface wave spectral obtained from a wave measuring buoy. Low pass filtered time series showing perturbations at internal wave frequencies are also presented.

DESIGN AND CALIBRATION OF AN ELECTRODYNAMIC DRIVER FOR THE SPACE THERMOACOUSTIC REFRIGERATOR

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and
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B.A.E., Auburn University, 1982
Master of Science in Engineering Acoustics - June 1989 and December 1989
Advisors: T.J. Hofler and S.L. Garrett- Department of Physics

The objective of the STAR project is to test and space qualify a continuous cycle cryogenic refrigeration system for the cooling of sensors and electronic based upon the thermoacoustic heat pumping effect. This thesis describes the design, assembly, and calibration of the electrodynamic driver and its associated performance monitoring and control instrumentation. The electroacoustic efficiency of the driver is measured under different operating conditions utilizing a prototype refrigerator resonator. These results are then compared to modelled efficiencies derived from a computer simulation program that uses the independently measured individual component parameters to predict the driver performance. Good agreement between measured and predicted efficiencies is observed. Highest electroacoustic efficiencies are shown to occur when the resonance frequencies of the driver and resonator are most closely matched. A maximum electroacoustic efficiency of 50% is achieved under these conditions. More important however, is that the efficiency decreases by only 10% over a 30% bandwidth about resonance.

COMPUTERIZED MEASUREMENT OF THERMOACOUSTICALLY GENERATED TEMPERATURE GRADIENTS

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The computerized measurement of thermoacoustically generated temperature gradients in short, thin plates is reported. The computerized data acquisition system is delineated. The temperature difference developed across a stack of short plates was measured as a function of the longitudinal position of the plates in a resonant tube for acoustic pressure amplitudes of 0.5 to 6.6. kPa, and static (or mean) pressures from 100 to 440 kPa, in argon and helium for the first through the third harmonic frequencies of the tube. Measured data were compared with predictions based on work done by Wheatley and others [J. Wheatley, et al., Journal of the Acoustical Society of America, v. 74, pp. 153-170, 1983] and results reported by Muzzerall (Master's Thesis in Engineering Acoustics, Naval Postgraduate School, Monterey, CA., September 1987). For low acoustic and static pressures, there is good agreement between measured data and theory. As the acoustic pressure amplitudes increase, there is a general degradation of agreement up to the point at which it appears saturation of the thermoacoustic effect occurs.

BUBBLE DETECTION USING A DUAL FREQUENCY SOUND FIELD

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Master of Science in Engineering Acoustics and Systems Technology, December 1988
Advisor: A.A. Atchley - Department of Physics

The design, testing and analysis of a dual frequency system to detect and determine the resonance frequency (and hence the size) of bubbles ranging from 100 to 7 um radius is reported. The resonance frequencies were compared to estimates based on the rise time of the bubbles. In general these comparison agreed to within five percent. Although the system is not ideal for field measurements, it identifies important requirements concerning the size of the sample volume, the frequency and amplitude ranges of the sound fields and signal processing techniques to make an effective system. Bubbles are distinguished form non-gaseous particles by the nature of their nonlinear response to the dual sound field. The system is versatile and can be modified to suit research purposes.

COMPUTER STUDIES OF SOUND PROPAGATION IN A WEDGED-SHAPED OCEAN WITH PENETRABLE BOTTOM

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Master of Science in Engineering Acoustics - March 1989
Advisors: A.B. Coopens and J.V. Sanders - Department of Physics

The sound distribution everywhere within a wedge-shaped fluid overlying either a slow or a fast bottom has been studied in this research. Collecting all the results of the previous works in this area and overviewing them has been the primary purpose. All the cases reported earlier have been studied, and some new ones have been added. The variation of the transition point distance with the shore distance as a variable was observed. In addition, the isopressure patterns were verified by calculating the pressure amplitudes in axial direction.

MEASUREMENTS OF BUBBLE PROPERTIES USING A MULTI-FREQUENCY SOUND FIELD

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Master of Science in Engineering Acoustics and Physics - June 1989
Advisor: A.A. Atchley - Department of Physics

An apparatus was designed, constructed, and tested to measure properties of single bubbles in a fluid by use of a multi-frequency sound field. The theoretical background on the dual frequency method for obtaining bubble properties such as resonance frequency, rectified diffusion thresholds and rates, rise-time sizing, and damping coefficients are discussed. Specifications and design of the device are presented. Sizes of single air bubbles in water determined from dual frequency methods are compared to rise-time sizing. For radii from 30 to 115 um, these two methods are shown to agree within 1%. Rectified diffusion rates measured above at and below threshold for an initial bubble radius of 50 um in air saturated water over a period of 700 seconds were measured and the results demonstrate the reliability of the system. The potential of this device to measure damping coefficient is discussed.

MONTEREY BAY ACOUSTIC TOMOGRAPHY: SIGNAL PROCESSING USING MULTI-CHANNEL DATA-SYNCHRONIZED QUADRATURE PHASE DEMODULATION

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Master of Science in Engineering Acoustics and Applied Science, September 1989
Advisor: J.H. Miller - Department of Electrical and Computer Engineering

An ocean acoustic tomography experiment was conducted in Monterey Bay from December 12-16, 1988 and had the following goals: 1) validate theories describing the relationship between acoustic travel time fluctuations and ocean waves, both surface and internal, 2) determine the effects of the complex bathymetry of Monterey Bay Submarine Canyon on acoustic propagation, and 3) test the first shore based acoustic tomography data acquisition system. This thesis developed a multi-channel data synchronized quadrature phase demoudulator for pre-processing the acoutic data. The demodulator fed the resulting baseband signals to a Zenith personal computer equipped with an A/D board for further processing. Preliminary results of the data analysis for one of the receiving stations is given to demonstrate the system effectiveness.

A LINEAR SYSTEMS THEORY APPROACH TO
THE RANGE-INDEPENDENT ACOUSTIC CHANNEL

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Master of Science in Engineering Acoustics and Electrical Engineering, June 1989
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Using linear systems theory as a framework, the solution for the acoustic field present in a range independent acoustic channel excited by a complex weighted, planar array of point sources with an arbitrary input electrical signal is derived. The ocean medium is characterized by a transfer function, obtainable as the solution to the Helmholtz wave equation. The transfer function for an isospeed, three layer waveguide is derived. The unbounded homogeneous medium equations are derived as a special case of the waveguide problem. The problem of interference due to the presence of a pressure release surface is also derived as a special case. The linear systems approach lends itself to a modular computer implementation, in which different ocean medium models are represented by subroutines implementing their transfer functions. The equations for a range-independent medium are implemented as a group of subprograms. Results are presented for the special cases of a homogeneous medium and the surface reflection problem, which can be checked against known, easily interpreted analytical solutions. Finally, an example of waveform prediction for the isospeed, three-layer waveguide is presented.

MASTER OF SCIENCE
IN
ENGINEERING SCIENCE

A FAULT TOLERANT SOFTWARE ALGORITHM FOR A NETWORK OF TRANSPUTERS

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Master of Science in Engineering Science
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This thesis presents a software algorithm that resends work packages to processors when one or more of the worker processors fails or when the link with one or more processors fails. There are two resend criteria used in this algorithm: "resend at end of initial assignment" and "resend at time out." The work, divided into several packages in order to run on several processors in parallel will be completed as long as least one worker processor remains working and communicating with the main processor. This algorithm could add some fault-tolerance to computer processing equipment in embedded systems.

HOLOGRAPHIC INVESTIGATION OF SOLID PROPELLANT COMBUSTION

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Master of Science in Engineering Science - December 1988
Advisor: D.W. Netzer - Department of Aeronautics and Astronautics

An investigation into the behavior of aluminized solid propellant combustion in a two dimensional windowed rocket motor was conducted using holographic techniques. Holograms were recorded in the motor port, aft of the propellant grain and at the entrance to the exhaust nozzle for two different propellant compositions at varying operating pressures. Quantitative particle size data for particles larger than 20 microns were obtained from the holograms. From these data, the mean diameters (D32) of the larger particles were calculated and utilized to compare what effects pressure, location in the motor and aluminum content had on the behavior of the aluminum/aluminum oxide particles. D32 was found to decrease with increasing pressure, but was unaffected by variations in low values of propellent, but was unaffected by variations in low values of propellant aluminum loading. D32 at the grain exit was found to be significantly less than within the grain port.

HELICOPTER CONTROLLABILITY

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Master of Science in Engineering Science - September 1989
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The concept of helicopter controllability is explained. A background study reviews helicopter development in the U.S.. General helicopter configurations, linearized equations of motion, stability, and piloting requirements are discussed. Helicopter flight controls, handling qualities, and associated specifications are reviewed. Analytical, simulation and flight test methods for evaluating helicopter automatic flight control systems are discussed. A generic simulation is also conducted. This thesis is intended to be used as a resource document for a helicopter stability and control course at the Naval Postgraduate School.

NUMERICAL ANALYSIS OF DOUBLE DELTA ANTENNAS VOLUME I

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Master of Science in Engineering Science - December 1988
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The Double Delta antenna is an HF communication antenna which exists in many forms throughout military communication commands. Performance characteristics for existing designs are presently unknown and are required in order to recommend an optimum design. This thesis investigates Double Delta antennas used by the US Army (lowband and high-band), the US Air Force (lowband and highband), and a commercial model. Selected models are analyzed by a computer simulation method using the Numerical Electromagnetics Code (NEC). The antenna designs are investigated to determine optimum performance characteristics over the 2-30 MHz range of frequencies. The parameters calculated were input impedance, VSWR, and antenna gain radiation patterns. For the performance of the antennas when sighted near lossy ground, the Sommerfeld method was employed. Finally, the results of the evaluation are presented and recommendations are made.

A ROBUST CONTROL OF A VERTICAL-PLANE MOTION FOR AN ELECTROHYDRAULICALLY-ACTUATED SINGLE-FLEXIBLE-LINK ARM

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Master of Science in Engineering Science - September 1989
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A sliding-mode control is designed and implemented for an electrohydraulically, actuated single flexible link arm. The arm was designed to carry various loads up to 2.27 kg achieving a load/width ratio of 0.45 and is operated at a high speed since the bandwidth of the control is designed being higher than that of the system model. The objective of this research is to study and evaluate the robustness of the sliding mode control in changing payloads. A switched control is first studied, in which an undesired high-frequency control signal appeared. By introducing a boundary layer neighboring the sliding surface, a continuous control is secondly used to trade accuracy against chattering. To implement the robust control, the bounds for system parameters are estimated using the non-robust control simulation of the robust control is then conducted and the hardware testing is also performed.

UTILIZATION OF A KALMAN WITH LARGE SPACE STRUCTURES

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Master of Science in Engineering Science - December 1988
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Control of the motions and vibrations of large space structures requires the knowledge of state values that may not be available due either to inability to measure the states or, the high cost of the sensors to measure the required states. One solution is the use of an observer to estimate the states from limited sensor input. The physical characteristics of large space structures and the environment they operate in will cause large amounts of noise in the measurements. The obvious observer for such an environment is the Kalman Filter which is specifically designed to produce optimal estimates in a noisy environment. A straightforward application of the Kalman Filter will be examined utilizing a steady state Kalman gain matrix. The observer performance will be examined in both matched filter plant and reduced order filter configurations.

FLOWFIELD MEASUREMENTS IN THE VORTEX WAKE OF A MISSILE AT HIGH ANGLE OF ATTACK IN TURBULENCE

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The flowfield downstream of a vertically launched surface to air missile model at an angle of attack of 50 degrees and a Reynolds number of 1.1 x 105 was investigated in a wind tunnel at the Naval Postgraduate School. The goal of this thesis is to experimentally validate the pressure measurement system for flowfield variables with elevated levels of turbulence; to determine the location and intensity of the asymmetric vortices in the wake of the VLSAM model at a raised level of freestream turbulence; and to display the asymmetric vortices by a velocity mapping and pressure contours. The purpose is to correlate the results with the force measurements of Raband to provide a greater understanding of the vortex flowfield. The body only configuration was tested. Two flowfiled conditions were treated; the normal ambient wind tunnel conditions, and a condition grid generated turbulence of 3.8% turbulence intensity and a dissipation length scale of 1.7 inches. The following conclusions were reached:1)The relative strengths of the asymmetric vortices can be noted by the sharp spike shape in the ambient condition; this condition becomes diffused and becomes fatter in the turbulent condition; 2) The right side vortex has greater strength than the left side one as seen by the diffusion in the total pressure coefficient and static pressure coefficient controls with and without a turbulent condition; 3) an increase in turbulence intensity tends to reduce the strength of the asymmetric nose generated vortices and pushes the two asymmetric vortices closer together; 4)and crossflow velocities were examined and were found to indicate the behavior denoted by the pressure contours.

A COMPUTER SIMULATION STUDY OF MISSION PLANNING AND CONTROL FOR THE NPS AUTONOMOUS UNDERWATER VEHICLE

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Master of Science in Engineering Science - June 1989
Advisor: R.B. McGhee - Department of Computer Science

Autonomous vehicles will operate where humans cannot or do not want to go. The last decade's advances in computer processor capability and speed, component miniaturization, signal processing and high energy density power supplies have been made. Remotely-operated vehicles now perform a number of tasks in research, industrial, and military applications, but they are still incapable of truly autonomous behavior. The U.S. Navy has identified a number of autonomous vehicle missions, and the Naval Postgraduate School is extending ROV technology to build an autonomous underwater vehicle (AUV). The mission controller for the NPS AUV is a knowledge based artificial intelligence (AI) system requiring thorough analysis and testing before the AUV is operational. Rapid prototyping of this software has been demonstrated by developing controller code on a LISP machine and using an Ethernet link with a graphics workstation to simulate the controller's environment. This thesis updates and improves the earlier simulator and its hardware, and describes the development of a new testing simulator designed to examine the AUV controller subsystem and vehicle models before intergrating them with the full AUV for its test environment missions. This AUV simulator is fully autonomous once initial mission parameters are selected.

THERMAL IMAGES OF SKY AND SEA-SURFACE BACKGROUND INFRARED RADIATION

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Master of Science in Engineering Science - December 1988
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Thermal images of the sky and the sea surface background radiance were analyzed using the AGA Thermovision 780 system. Calculated sky radiance was compared with that predicted by the computer code LOWTRAN 6. The Schwartz-Hon computer model for the emissivity of the sea surface was validated using the results from AGA measurements and LOWTRAN 6. The factors which affect the radiance measurements were determined, and the degree of influence they exert was estimated. The radiance emitted form an overcast sky was found to be higher than that emitted form a clear sky. The wind speed reduced significantly the infrared sky radiance. Emissivity of the sea surface depends upon the wave roughness, remaining almost constant with the viewing angle. The results showed that LOWTRAN 6 provides a good prediction of the atmospheric radiance with deviation form measurement generally within 10% with cases to 15%, for the elevation angle range from 0 to 19 degrees and the Schwartz-Hoh model agrees well with observation showing deviation varying up to 14% in the elevation angle range form 5 to 10 degrees.

AN INTELLIGENT COMPUTER ASSISTED INSTRUCTION SYSTEM FOR UNDERWAY REPLENISHMENT

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This research discusses the design, implementation,and testing of the UNREP system, an Intelligent Computer-Assisted Instruction (ICAI) turoting system to simulate Underway Replenishment Operations by Training two students simultaneously on separate computer workstations. Each student plays the role of the Officer of the Deck (OOD) aboard each of the ships involved. Emergency situations are included to add realism to the simulation. While several different ICAI systems have been developed in the past, few have focused on the coordination aspects of applications which involve cooperation in joint activities, such as military operations. Artificial Intelligence (AI) techniques and programming tools were employed to construct this system. Education and training in the military, ICAI systems for military applications, ICAI general characteristics, Knowledge representation, and time and task coordination are some of the topics discussed in this thesis.

AN EXPERIMENTAL INVESTIGATION IN THE BEHAVIOR OF METALLIZED SOLID PROPELLANTS

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Master of Science in Engineering Science - December 1988
Advisor: D.W. Netzer - Department of Aeronautics and Astronautics

The combustion behavior of metallized solid propellants at pressures between 100 and 750 psi was investigated using high speed motion pictures together with scanning electron microscope and light diffraction examinations of collected residue. Reduced smoke ZrC propellants with low loadings were utilized. ZrC was observed to agglomerate and ignite on the propellant surface before being ejected. The aluminum did not agglomerate, but did ignite on the propellant surface. ZrC was found to burn in part with a detached flame and the flame moved closer to the particle surface as pressure increased. Aluminum particles were observed to burn with similar behavior, but with flames more detached form the particle surface. Increased aluminum loading resulted in smaller particles above the propellant surface, but the flames were further from the particle surface.

FLOWFIELD EFFECTS OF A LAUNCH ON A VERTICALLY-LAUNCHED MISSILE

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Master of Science in Engineering Science - June 1989
Advisor: R.M. Howard - Department of Aeronautics & Astronautics

The flowfield about a Vertically Launched Surface to Air Missile model at an angle of attack of 50 degrees and a Reynolds number of 1.1x105 was investigated in a low speed wind tunnel at the Naval Postgraduate School. The goal of this thesis is to determine the location and intensity of the asymmetric vortices in the wake of the VLSAM model and to display these vortices by velocity mapping and pressure contours. The two model configurations tested were for a cruciform missile with wings and tails; one at 0 degrees roll angle ("plus" aspect) and the other at a 45 degrees angle (""Cross" aspect). Two flowfield conditions were treated: the nominal ambient wind tunnel condition and a condition with a grid-generated turbulence of length scale 1.08 inches and 1.88% turbulence intensity. The turbulence length scale is 61.7% of the model diameter and 4.7% of the model

length. The following conclusions were reached: 1)An increase in turbulence intensity tended to reduce the strength of the asymmetric nose-generated vortices; 2)the two asymmetric vortices remained in approximately the same position for an increase in turbulence; 3) "cross" aspect vortices were more diffused, slightly larger and centered further away from the model surface than those of the "plus" aspect body configuration, which correlates with the difference in induced side forces for these configurations observed by Rabang; 4) the top vortex of the two asymmetric vortices was closer to the model surface and appeared to be stronger for both configurations; and 5) the addition of wings and tails did not greatly alter the vortex pattern around the nose of the missile model.

INVESTIGATION INTO THE FEASIBILITY OF USING SOLID FUEL RAMJETS FOR HIGH SUPERSONIC/LOW HYPERSONIC TACTICAL MISSILES

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Advisor: D.W. Netzer - Department of Aeronautics & Astronautics

An investigation was conducted to determine the feasibility of using solid fuel ramjets as propulsion units on high supersonic/low hypersonic tactical missiles. Experiments were conducted on two types of configurations. Plexiglas was used as the fuel in scamjet and HTPB was used as the fuel in a dual mode combustor. Results indicated that supersonic

combustion occurred in both configurations, but that mixing and heat addition losses were high. Ignition limits were identified as a possible limiting factor in the use of solid fuels for the proposed application. Combustion kinetics were shown to be rapid enough to support sustained combustion in supersonic flow.

MASTER OF SCIENCE
IN
HYDROGRAPHIC SCIENCE

COMPARISON OF MEASURED AND TRANSFORMED DIRECTIONAL WAVE SPECTRA USING LINEAR REFRACTION MODEL

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Master of Science in Hydrographic Sciences
and Oceanography, March 1989
Advisor: E.B. Thornton - Department of Oceanography

Deep water directional wave spectra, measured by a NDBC 3-meter buoy off Monterey Bay, are transformed to shallow water using the linear refraction model by Dobson (1967). The transformed directional spectra are compared with measured spectra using pressure gauge arrays in shallow water at Marine and Santa Cruz. Refraction (Kr), shoaling (Ks) and Jacobian (J) transfer functions are computed. The modeling results and measured wave data at Marine are in good agreement for easterly waves at high frequencies. On the other hand, the linear refraction model gives highly variable values of wave solutions at Santa Cruz. It is believed that the unrealistic wave results at Santa Cruz are associated with the complex bathymetry of Monterey Bay. The present work examines the accuracy and limitations of linear refraction model by field observations.

DIFFERENTIAL LORAN-C USING THREE SECONDARY STATIONS

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Loran-C time difference (TD) readings were taken consecutively at several survey stations near Monterey, CA, over a period of three days. One station, Range 7, was designated the "known" point of a differential Loran-C system. Readings from the known point were used to correct readings from a second survey station, Luces Point. A method of improving the precision of Loran-C TD readings based on the redundancy and relative accuracy of three LOP's was developed and applied to the data. Since only one receiver was available, a linear regression of TD vs time was calculated and used in the differential correction. Based on 496 sets of data taken at 5 second intervals at Range 7 in two groups, before and after 250 readings at Luces Point, the absolute accuracy of Luces Point data was improved from about 385 m to about 48 m compared to the known position of the point. Precision was improving from about 14.9 m to about 12.6 m circular error (CEP) using the three station correction. Further improvement would probably have results if two receivers were available for real time corrections.

MASTER OF SCIENCE
IN
INFORMATION SYSTEMS

NAVAL MAINTENANCE DECISION SUPPORT SYSTEM

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and
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March 89
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This is a Decision Support Expert System design proposal for the Naval Aviation Maintenance Control environment. A survey of contemporary literature concerning the use, development and implementation of such systems is conducted. A general examination of the decision maker's problem domain including the organizations, requirements and constraints is presented. Design criteria are identified. An adaptive prototype approach to design and system development is strongly recommended. Value analysis is suggested as the method for justification of the system. Specific recommendations for future development and implementation of the system are made.

3COM ETHERSERIES LOCAL AREA NETWORK

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The purpose of this thesis is to provide an overview of the requirements and protocols required for the implementation of an Ethernet LAN. The appendix to this thesis is a User's Manual for the 3Com Ether-Series Network version 2.4. The manual is specifically written for use in the Administrative Sciences Department Information Systems lab at the Naval Postgraduate School.

NAVAL SUPPLY SYSTEMS COMMAND: DATA ADMINISTRATION PLANNING AND IMPLEMENTATION

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and
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The Paperwork Reduction Act of 1980 mandated that federal government activities establish and endorse Information Resource Management policies. It also recommended the establishment of a Data Administration Branch within federal activities to provide an organizational entity devoted to effective information management. This study presents guide-lines for the successful implementation of Data Administration, describes a standard for an Information Resource Dictionary System (the Data Administrator's primary tool), and makes recommendations for planning an Information Resources Dictionary System Implementation.

CASE TECHNOLOGY AND THE SYSTEMS DEVELOPMENT LIFE CYCLE: A PROPOSED INTEGRATION OF CASE TOOLS WITH DOD STD-216A

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The use of Computer Aided Software Engineering (CASE) tools has been marketed as a remedy for the software development crisis by automating analysis, design, and coding. The systems Development Life Cycle (SDLC) has been employed in an attempt to ease the development backlog by applying structured methods to the development of software systems. This study reviews CASE tool components and the future of CASE integrated toolkits, compared an SDLC with the Defense System Software Development standard - DoD STD 216A, and proposes a mean for integrating CASE tools into the Dod STD 2167A system life cycle.

A PERSONAL-COMPUTER BASED DSS FOR DIABETES CONTROL AND MONITORING

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and
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Diabetes is a serious disease that affects many people. The military medical system is one of the largest medical systems in the world, and treats a significant number of dependent diabetics. As with most sections of the military, the medical community is understaffed. This results in most facilities lacking adequate medical care for these patients. The key to the treatment is control of blood glucose levels and the contributing factors, such as food and exercise. By controlling these factors, large fluctuations in the glucose levels can be minimized. A decision support system that enables both the medical personnel and the patient to manage these factors could vastly improve treatment and mitigate the side effects of diabetes. This paper will address how such an approach can be applied to diabetes resulting in better medical care and decrease the demand on a stressed medical system.

NAVAL WARFARE TACTICAL DATA BASE: IMPLEMENTATION ON AN INFORMATION RESOURCE DICTIONARY SYSTEM

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and
Todd Arthur Van Gunten - Lieutenant, United States Navy
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Master of Science in Information Systems - March 1989
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The substantial use of database technology in the collection and dissemination of information of the Naval tactical system requires extensive data administration support. The Naval Warfare Tactical Database format and structure, currently lacks sufficient data administration tool to provide an adequate level of data management and control. The feasibility of converting the NWTDB to an Information Resource Dictionary System (IRDS), which will yield an enhanced dictionary capability, is investigated. An analysis of the enhancements generated by conversion of a passive to active IRDS is also discussed. This research concluded that an IRDS implementation can produce extensive benefits for NWTDB and others.

OPTICAL LASER TECHNOLOGY AND ITS APPLICATION TO DEFENSE MANPOWER DATA CENTER'S (DMDC) QUERRY FACSIMILE (QFAC) DATABASE SYSTEM

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Master of Science in Information Systems - March 1989
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Optical storage technology is in the headlines as one of today's newest and most promising technological advances. It holds the capability to increase the amount of data stores on a single 5 1/4-inch disc from 1.2 Megabytes (MB) to 640 MB. The three basic typed of optical disks, Compact Disk-Read Only Memory (CD-ROM), Write Once, Read Many (WORM), and erasable optical, each have their own application niche. For this reason, it is critical for managers to analyze present systems carefully prior to seeking optical storage solution. An in-depth evaluation of performance and interfacing requirements of currently marketed optical systems was performed. That evaluation was used in the process of determining if Defense Manpower Data Center's (DMDC) Querry Facsimile (QFAX) System, a system of nine databases currently stored on a direct access storage device (DASD), was a candidate for an optical storage application. Additional consideration was given to industry standards for optical devices. A detailed analysis of the current system configuration and end-users requirements was made to determine acceptability of optical systems interfaces and associated capabilities.

DESIGN AND IMPLEMENTATION OF A PROTOTYPE DATABASE FOR THE ANALYSIS OF STUDENT OPINION FORMS FOR THE ADMINISTRATIVE SCIENCES DEPARTMENT, NAVAL POSTGRADUATE SCHOOL, MONTEREY, CA.

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Master of Science in Information Systems - September 1989
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The Naval Postgraduate School currently collects and disseminates the data form Student Opinion Forms (SOF) on a quarterly basis. After all SOF reports are routed to the academic departments and the instructors, the data is archived on a magnetic tape. Until recently, there was no method of retrieving this data for use in the classroom environment research or for instructor evaluation purposes. This thesis develops a prototype database for the analysis of Student Opinion Forms (SOFA) for the Administrative Science Department using FOCUS database management system. It will be used to retrieve SOF data and to produce reports and graphics which will assist the chairman, his representatives, and department Researcher in examining the historical data relating to courses, curricula or instructors. SOFA will greatly assist department personnel in making reasonable inference regarding instructor performance, class room environment, student curriculum and other factors which may be affecting the learning environment.

EXPERIMENTAL RESEARCH AND EMPIRICAL TESTING OF DISTRIBUTED GROUP DECISION SUPPORT SYSTEMS

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and
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Master of Science in Information Systems, 1989
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Past research in the area of Group Decision Support System (GDSS) has attempted to ascertain its future potential in the business world. This thesis extends the GDSS research to the area of distributed Groups Decision Support Systems (DGDSS). An experiment was performed where groups of three and four persons were tested in different decision making settings, a traditional decision room and DGSS. An experimental prototype DGDSS program, developed at Claremont University, Claremont, CA, was evaluated during the experiment. The experiment pointed out several program advantages and disadvantaged during the evaluation. The study determined that use of the DGDSS resulted in generation of larger numbers of criteria and alternatives and great satisfactions. DGDSS supported groups experienced, less commitment to the final decision, and less satisfaction with communication.

DEVELOPING A COMPREHENSIVE METHODOLOGY FOR COMPUTER FAMILY SELECTION

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A methodology to select a computer family, a group of computers from microcomputer to mainframe with compatible operating systems and software, using an adjective evaluation process is developed. Saaty's Analytical Hierarch Process (AHP), for weighting and ranking process, is applied to the basic methodology presented by Borovits and Zviran for computer family selection. The result is a comprehensive methodology to more objectively select a computer family.

FUNCTIONAL SPECIFICATIONS TO AN AUTOMATED RETINAL SCANNER FOR USE IN PLOTTING THE VASCULAR MAP

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The connection between eye disease and diabetes is proven and is no longer a point of conjecture. In focusing attention on the retina, profound inroads have been made in the fight against this dreaded disorder of the blood. By carefully imaging the blood vessels in the back of the eye, medical professionals can make accurate diagnoses based upon the changes and abnormalities observed. In addition, because the vasculature in the retina is extremely sensitive to fluctuations in normal bodily processes, often the first indication of diabetes and many other diseases manifest themselves here and are found during routine eye examinations. This thesis will explore the possibilities of a new method of retinal imaging by the blending and application of existing technologies. With the use of an automated infrared-based imagine system, problems related to human error and the limitations of existing methods can be readily resolved and the ground work can be laid for a new standard of accuracy in retinal imaging. Most importantly, it will automate the entire procedure providing medical specialists heretofore unavailable accuracy in their diagnoses.

A CONCEPTUAL LEVEL DESIGN OF A DESIGN DATABASE
FOR THE COMPUTER - AIDED PROTOTYPING SYSTEM

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Vast amounts of evolving data are created in the design of hard real-time software systems. This data must be managed so that it can be stored and retrieved according to the needs of design engineers. In the Computer - Aided Prototyping System (CAPS), a Design Database (DDB) must manage the storage and retrieval of the entire Prototype System Description Language (PSDL) program. This thesis presents a conceptual design and initial implementation of a Design Database (DDB) for the Computer - Aided Prototyping System (CAPS).

APPLICATION OF VOICE RECOGNITION INPUT TO DECISION SUPPORT SYSTEMS

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The goal of this study was to provide a single source of data that enables the selection of an appropriate voice recognition (VR) applications. A brief background of both voice recognition systems and decision support systems is provided with special emphasis given to the dialogue component of DSS. The categories of voice recognition discussed are human factors, environmental factors, situational factors, quantitative factors, training factors, host computer factors, experiments and research. Each of these areas of voice recognition is individually analyzed, and specific references to applicable literature is included. This study also includes appendices that contain: *A glossary of phrases specific to both decision support system and voice recognition systems and a definition to their use. * Keywords applicable to this study. *An annotated bibliography (alphabetically and by specific topics) of current VR systems literature containing over 200 reference. *An index of publishers. * A complete listing of current commercially available VR systems.

THE EFFECT OF THE GOLDWATER-NICHOLS DEPARTMENT OF DEFENSE
REORGANIZATION ACT ON TACTICAL AVIATION PILOT AND NFO CAREER PATHS

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This thesis presents a computer aided analysis of the effects of implementing the requirements of the Goldwater-Nichols Department of Defense Reorganization Act on the career paths of U.S. Navy Tactical Aviation (TACAIR) pilots and Naval flight officers. The method of TACAIR community data collation, and the user interactive personnel flow forecasting model, FORECASTER, are thoroughly documented. In the analysis, the FORECASTER model is run through several iterations, each iteration devoted to satisfying the next lower priority billet requirements, beginning with Joint Duty Assignments and ending with "soft" shore duty billets. The effects of each iteration is carefully examined to assess any positive or negative impact on the TACAIR community. The results of this analysis show a deterioration of warfighting skills of TACAIR field grade officers, and a decreased ability to fill "soft" billets from the TACAIR community.

THE ESTABLISHMENT OF A MANAGEMENT INFORMATION SYSTEMS RESEARCH CENTER AT THE NAVAL POSTGRADUATE SCHOOL

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This thesis investigates the opportunity for the establishment of a Management Information Systems research center at the Naval Postgraduate School and the unique purpose it would serve within the Department of Defense Community. Following the analysis of five existing information systems research centers and their various objectives and activities, pertinent issues regarding the Naval Postgraduate School are identified through interview of relevant faculty and staff. A mission is identified for Naval Postgraduate School "Information Systems Research Center," and a strategy involving the center's objectives and activities is suggested.

MOVING OPTICAL TECHNOLOGY IN-HOUSE

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The Navy, through a series of projects and programs, is identifying a considerable number of uses for optical technology. Key commands and Navy projects using optical technology are identified and reviewed. Currently, the Navy projection facility exist for classified data. The issue is whether the Navy should develop anoptical technology production facility to avoid the use of outside contractors. This research looks at current costs for producing CD-ROM and what cost saving might be incurred through the in-house use of this technology. And if the technology were developed internally, questions such as who should manage this program and how should it be managed needs to be addressed. The impact and benefits and barriers to developing an optical technology in-house capability in the Navy are summarized.

DEFINITION OF A DECISION SUPPORT SYSTEM (DSS) FOR USE BY APPLICATION DEVELOPER WITHIN THE COMMON FRONT-END SYSTEM ARCHITECTURE AT THE MARINE CORPS CENTRAL DESIGN AND PROGRAMMING ACTIVITY, KANSAS CITY, MO.

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Applications development personnel have been confronted with the task of creating efficient applications to meet the need of the end-user. Developers have tried to meet these needs by building their own individual routine libraries, but the side range of skill levels and the large backlog of application requests have kept developers and end-user largely satisfied. Under the new Common Front-End System Architecture, developers will have access to a tool box of common functions that will help reduce development time for all levels of applications. A Decision Support system (DSS) designed to aid development personnel in gaining access to the data functions necessary for their development efforts is desired by the Marine Corps to support Manpower and Pay systems. The creation of such a DSS will entail gathering data concerning access patterns to tool box functions and database elements, definition of specific tool box functions to be utilized by the DSS, and definition of the decision logic and rule processing for use in determining all the related elements of a transaction.

AN ANALYSIS, DESIGN, IMPLEMENTATION OF THE ADMINISTRATIVE AND PERSONNEL FUNCTIONAL AREAS OF ARGOS

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ARGOS is a prototype multi-media database system developed by CDR B.B. Giannotti and Lt K.F. Duffy at the Naval Postgraduate School for their master's thesis. They describe how ARGOS can be used by the Battle Group Commander and Shipboard personnel as an efficient and dynamic management and decision support tool. Their system was developed as a direct outgrowth of the "paperless ship" philosophy expressed by VADM Metcalf and has had many supporters in DOD. This thesis furthered their research by analyzing and designing the administrative and personnel function areas of ARGOS. The functions and processes identified were then partially implemented. ARGOS as a prototype system provides an effective and rapid method of redeveloping and evaluating management tools and decision aids. This implementation demonstrates benefits such a system would have for the Navy.

A PROTOTYPE FOR CONVERTING LINEAR PROGRAMMING (LP) MODELS TO STRUCTURED MODELING GRAPHS

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Geoffrion's structured modeling provides a very promising frame work for the development of future model management systems (MSS). This thesis presents a prototype that convert a mathematical representation of simple LP models to Geoffrion's structured modeling representations. The general procedures presented could be extended to convert an LP model represented in any precisely defined mathematical language. This would allow the development of integrated modeling environments based upon the structured modeling framework which would accept input in a number of common P language formats.

USE OF OPTICAL STORAGE DEVICES AS SHARED RESOURCES IN LOCAL AREA NETWORKS

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Since the start of the computer era, information users have been restricted by inadequate and expensive data storage. The development of solid state memory, soft storage media (floppy disk drives), drum memory drives and fixed disk drive mechanisms have improved data storage and retrieval, reducing the cost of information to under $10 per megabyte for large storage devices. The introduction of laser technology and the development of optical data storage now make tremendous amounts of data available to users. Optical disc drives can be accessed as peripheral devices by most stand alone micro-computers at a cost of less than $.30 per megabyte of information. Although the cost per megabyte is low, the cost per work station can run $1500 to $2500 (or more) per year. Optical storage devices and the data bases released in optical format can be: 1) too expensive for addition to individual work stations or 2) under utilized in a single user environment or 3) difficult to manage when two or more users share a single station. Current networking strategies have the potential to reduce data costs even more by allowing data storage devices to be shared by multiple users. This study evaluated the possibility of combining Optical Storage Technology with the data sharing properties of a Local Area Network (LAN) to solve these three problems.

INFORMATION CENTERS IN THE UNITED STATES ARMY: MOVEMENT TOWARD MATURITY THROUGH STRATEGIC PLANNING

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This thesis reports the results of research focused on US Army information center and end-user computing management techniques. The effort is designed to provide insight into issues and trends in information center management, end-user computing, and Army information resource management. Models for managing the evolution of individual and organizational computing are presented in terms of their applicability to Army information resource management. Important conclusions of this research were; 1) Achieving the level of information integration desired by Army leaders will require the development of management controls that focus on directing the evolution of end-user computing, 2) The role of information centers in Army information management is poorly defined. Resolving this situation will be an important part of achieving an integrated information environment, 3) End-user computing is a critical part of the information environment that has been virtually overlooked by information resource planners. The integration of this valuable resource into Army information source planning appears to be critical to the future of Army information processing.

COGNITIVE PASSWORDS: THE KEY FOR EFFECTIVE ACCESS CONTROL

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Passwords are a commonly used method of access control for computer systems. Traditional passwords have been found to be inadequate. Passwords are generated from two sources: users and computer systems. User-selected passwords are easy to remember, but they might be easily guessed and therefore yield a lower degree of security. System-generated passwords usually offer a higher degree of security, but they are hard to remember and therefore meet with high user resistance. Because of this user resistance, password systems are either circumvented or not used. A solution to this tradeoff between memorability and security is a security mechanism that is easily remembered, user friendly, hard to guess, and yields a degree of security. Cognitive passwords offer these advantages. They are based on a series of predetermined questions with answers known normally only by a specific user. Research into the underlying theory, types of applicable questions and implementation of a prototype system is conducted.

HYPERTEXT: ANOTHER STEP TOWARD THE PAPERLESS SHIP

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The original ideal of Paperless ship is a clear, concise, strategy statement that mandates paper reduction and office automation on ships. Its intent is to alleviate combat units of the serious limitations imposed by paper. Nevertheless, paper eradication is not desirable perse'. Rather, what is important is to develop a library of knowledge, electronically stored for ship board use. This thesis shows how using Hypertext for information retrieval fills a gap between MIS and decision support for unstructured problem solving.

By implementing the Boiler Water Feedwater Test and Treatment Manual, Vol. 1 in Hypertext using GUIDE and low end Personal Computers, this thesis demonstrates that electronically stored documents capture efficiencies not possible in hardbound text. Whether or not Hypertext can successfully eliminate all paper is arguable, but irrelevant. This thesis demonstrates that for the user interface, Hypertext is a desirable retrieval system because it is simple, friendly, and has a familiar look and feel.

INFORMATION CENTERS IN THE UNITED STATES NAVY: FUTURE SUPPORT FOR A COMPUTER LITERATE SOCIETY

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The objective of this thesis is to examine the current state of information Centers (IC's) in the United States Navy and the necessary steps that must be taken to support future end-user computing (EUC). The current trends in IC development in the corporate environment, pertinent models for controlling and promoting EUC, and the current policies governing existing IC'S within the U.S. Navy are examined providing background for recommendations. The Navy's current strategy for dealing with EUC can be characterized as being in its early developmental states. Little planning is being done dealing with the promotion or control of EUC. IC's have developed largely in reaction to user demand with little guidance from upper levels of management. As a results, those end-users geographically close enough to existing IC'S can make use of their EUC support services. Those removed form the IC'S influence suffer from the lack of support facility. The Navy is at an important state in supporting EUC growth and development. An increase in bureaucratic controls could stifle EUC growth. Fostering EUC through norm-based reinforcement and strategic support for IC's throughout the service will allow the Navy to capitalize on this new and developing phenomenon. As EUC continue to become more sophisticated in society, it becomes increasingly important to develop a strategic policy that allows growth and provides direction to end-users.

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JCS PLANNING: ASSESSMENT AND RECOMMENDATIONS

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Strategic planning by the Joint Chiefs of Staff (JCS) has been a source of criticism due to the lack of quality and timely military advice needed by the National Command Authorities (NCA). The 1986 Goldwater-Nichols Act made organizational changes to help solve JCS planning, but failed to address other fundamental problems such as the lack of Presidential participation in planning, the lack of recognition of strategic role of today's information technology in joint strategic planning and the lack of training and experience of planning officers. This thesis provides a high-level overview of both the Joint Strategic Planning System (JSPS) currently being revised, and the Joint Operation Planning and Execution System (JOPES) designed to improve deliberate planning by the unified and specified commanders. Conclusion and recommendations are given to address the DoD's decentralized and incompatible planning systems currently in use, and to improve the flow of information form the CJCS to the President.

INFORMATION CENTERS IN THE UNITED STATES MARINE CORPS: CONTROL OF END-USER COMPUTING

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The proliferation of personal computers and end-user computing (EUC) in the U.S. Marine Corps (USMC) during the last ten years is well documented and now plays and important role in USMC readiness. The control and planning of personal computers and EUC at the regional level is performed by the Information Systems Management Office (ISMO) the equivalent of the Private industry's Information Center. Unlike the USMC mainframe and telecommunications environments, the ISMO environment is loosely controlled from the headquarters Marine Corps Level. This fact has resulted in "substantial inventory of incompatible equipment and software." This study concludes that the most significant limiting factor facing the Marine Corps' corporate strategy for control of its ISMO's is a lack of standards and specific direction. The requirement for developing a centralized, HQMC directed ISMO policy for control of ISMO resources was confirmed.

DESIGN AND DEVELOPMENT OF AN EXPERT SYSTEM BASED QUALITY ASSURANCE MODULE FOR THE DYNAMO MODEL OF SOFTWARE PROJECT MANAGEMENT

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Quality assurance is a crucial function to the successful development and maintenance of a software system. Because this activity has a significant impact on the cost of software development, the cost-effectiveness of quality assurance is a major concern to the software quality manager. There are tradeoffs between the economic benefits and costs and quality assurance. Using the Dynamo model of software project management, an optimal quality assurance level and its distribution throughout a project's life-cycle can be identified. The focus of this thesis is to automate the process of identifying the optimum quality assurance level. An expert system was developed that, when interfaced with the Dynamo model, will generate the optimum quality assurance distribution for a given set of parameters. The ability of the expert system to generate more cost effective quality assurance levels than manually achievable was shown.

HYPERTEXT: IMPROVED CAPABILITY FOR SHIPBOARD NAVAL MESSAGES

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This thesis demonstrates how a new software technology, hypertext, can provide capabilities which will improve the handling and utilization of Naval messages on board ship. The current process for shipboard message handling involves the use of communication equipment, computers, duplication machines and such manual operations as control, distribution, annotation, filing and search. An Automated Message Handling System based on the hypertext concept offers opportunities to enhance each of these operations. The enhancements will come from performing required tasks in a more organized manner while requiring less dependence on paper and providing a far more efficient and effective means for using Naval messages as an information resource. Developments in computer technology make it feasible to implement such a system on currently available, low cost, commercial hardware. This thesis includes a logical design for a hypertext message system.

FLEET NUMERICAL OCEANOGRAPHY CENTER SOFTWARE DEVELOPMENT STANDARDS: AN IMPLEMENTATION OF DOD-STD-2167A

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Software development standards are integral to any organizational's software development efforts and are essential to the development life cycle. They are vital in ensuring on-time delivery of more reliable and maintainable software products. The trend in software development is toward a structured, systems engineering approach based on standard practices, methodologies and rigorous management control. DOD-STD-216A establishes uniform requirements for software development that are applicable throughout the system life cycle. It provides basis for government insight into a contractor's software development, testing and evaluation efforts. This thesis examines the possibility of developing a generic, tailored version of DOD-STD-2167A that would apply to an activities or general project categories software development needs. The analysis indicated that a tailored version of the standard can be developed to at least eliminate some requirements for a project categories software requirements, thereby reducing superfluous and duplicative activities.

DESIGN OF A RECRUITER SELECTION EXPERT SYSTEM

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This study attempts to identify the attributes associated with the successful recruiters. Using past research and interview with 13 recruiting experts, eight attributes were identified: conscientiousness, initiative, aggressive, outgoing, self discipline, maturity, stability and adaptability. An expert system was designed using these characteristics and the minimum requirements for assignment to recruiting duty given in the Navy's ENLISTED TRANSFER MANUAL. A recommended Commanding Officer's Screening Form was designed that will have all the data needed to be placed into the expert system. Recommendations for improvements of the prototype and follow-on study are presented.

PC TO MAINFRAME CONNECTION: IBM PC 3270 EMULATION

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The purpose of this thesis is to provide nontechnical information concerning microcomputer to mainframe connectivity utilizing terminal emulation. The focus is on IBM, and IBM compatible, microcomputers and on IBM PC 3270 Terminal Emulation. An appendix to this thesis is a User's Manual for the IBM PC 3270 Emulation Program, version 3.00. This manual is intended for use in the Administrative Sciences Department micro-computer labs of the Naval Postgraduate School.

REQUIREMENTS FOR STANDARD APPLICATIONS AND LOCAL AREA NETWORKS IN NAVAL AVIATION SQUADRONS

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This thesis will address unique characteristics and requirements for implementing a Local Area Network (LAN) and standard applications at the Naval Aviation squadron level. The introduction will present the history and basic concept of LAN's at squadrons as well as defining the problem that exists. Examples of Local Area Networks are presented to provide a basic understanding of the technology involved. The organization of Naval Aviation squadrons is discussed to illustrate the high level functional requirements. Areas to be covered in the requirements specifications are then discussed to ensure completeness and the overall success of this concept. Performance, documentation, training, support and security are a few of the issues that are addressed. Complete specifications, a coordinated and well thought out plan and designation of a project manager are critical elements that cannot be ignored if the project is to succeed.

CONVERSION OF MASS STORAGE HIERARCHY IN AN IBM COMPUTER NETWORK

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With the shift from batch applications to online systems supporting the strategic role of information, corporate or institutional goals tie directly to the information management functions. This has been true at the Naval Postgraduate School (NPS). Like many other Government installations, the NPS Computer Center has to meet its objectives with less than state-of-the-art hardware. In the early 1980's, the Center employed IBM's 3850 Mass Storage Subsystem (MSS) for online storage of student and faculty data sets. It was installed in December 1980 and performed well for over six years. Faced with IBM's announcement (in February 1985) of the limited future connectivity and compatibility and the increasing maintenance costs, the decision was made to replace the MSS with a hardware / software alternative that would use a more modern and reliable architecture. The objective of this thesis is to define the solution, the data set migration process, and describe the early experience with a multi-level, software- managed, storage system.

AN EXPERT MODEL FOR AN INTEGRATED INTELLIGENCE INFORMATION SYSTEM

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The current Marine Corps tactical intelligence information flow at battalion level is hierarchal in nature, and structured in design and syntax. It is completed manually using a checklist approach to ensure adequate control of the data flows. This thesis investigates the issues in developing and implementing an automated expert system for collecting and disseminating tactical intelligence, using commerically available systems. Back-ground, system objectives and an Integrated Knowledge Based System and Database Management System structured are discussed. Knowledge acquisition and revision through end-user computing using an off-the-shelf expert system are emphasized. A system requirements review is conducted to stress the need for further development through prototyping.

PLANNING AN INTEGRATED ON-LINE LIBRARY SYSTEM (IOLS)

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Requirements for an Integrated On-line Library System (IOLS) to automate the acquisition, cataloging and circulation functions of the Dudley Knox Library of the Naval Postgraduate School were matched against the capabilites of commercial IOL's available for purchase. NOTIS was the recommended choice. A cost analysis and implementation plan was developed for installing NOTIS at the Naval Postgraduate School.

A COMPARISON OF INFORMATION SYSTEMS AND NON-INFORMATION SYSTEMS PERSONNEL WORKING IN NON-INFORMATION SYSTEMS ORGANIZATIONAL DEPARTMENTS

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A survey was conducted to investigate motivational and satisfaction difference between Information Systems (IS) and non-IS personnel working in various non-IS organizational departments. The motivational factors of Motivating Potential Score (MPS), Growth Need Strength (GNS), Social Need Strength (SNS), Average Psychological Score (APS), and Overall Satisfaction Score (OSS) were measured. Control for occupational group differences was achieved by classifying survey respondents into one of two job categories: Managerial or Professional/Technical. Significant differences were found in the GNS scores and SNSs of the two job categories. Several implications of the research finding are discussed and recommendations are made with respect to future studies.

DESIGN AND IMPLEMENTATION OF AN OPERATIONAL DATABASE FOR THE FLEET AREA CONTROL AND SURVEILLANCE FACILITY NAS NORTH ISLAND, SAN DIEGO, CALIFORNIA

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The Fleet Area Control and Surveillance Facility FASC-FAC located at North Island, San Diego, currently performs its data collection, storage and processing functions manually. Expected expansion of the scope of operations at FACSFAC will overwhelm the present system. This thesis develops an ORACLE-based relational data-base system for use by FACSFAC. The system consists of two applications. In the scheduling application, inputs from various sources are compiled, allowing both a powerful query capability and the production of a weekly schedule of activities for the facilities and personnel assigned to FACSFAC. The exercise results application provides an automated method of gathering and querying pertinent tactical employment and range utilization data for required weekly, monthly and quarterly reports. The prototype system greatly facilitates the storage, query and reporting functions of the organization and promotes increased efficiency in daily operations.

DETAILED REQUIREMENTS ANALYSIS FOR A MANAGEMENT INFORMATION SYSTEM FOR THE DEPARTMENT OF FAMILY PRACTICE AND COMMUNITY MEDICINE AT SILAS B. HAYS ARMY COMMUNITY HOSPITAL, FORT ORD, CA

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This thesis analyzes the current management information systems in place at Silas B. Hays Army Community Hospital with in-depth research into the hospital's largest department, the Department of Family Practice and Community Medicine. The finding of the research indicate these system are not meeting the need of department managers within the hospital. This thesis contains a requirements analysis for an improved information system for the department. The process of identifying the targeted users, selecting the appropriate development methodology, and identifying the user's information requirements is discussed. The value of the information required by the department manager, both in content and format, is examined. The requirements analysis is based on a combination of system development life cycle and prototyping methodologies for information system development and can be used to design, construct, and implement an information system for the targeted department. The requirements analysis can also be used to study the expandability of the proposed information system to department throughout Silas B. Hays Army Community Hospital.

ANALYSIS OF THE EPMIS DATA BASE

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The Emergency Preparedness Management Information System (EPMIS) has been developed as part of a research project with the Defense Communications Agency to build a decision support system for tracking national communications system in times of emergency. The current EPMIS data base is implemented on the INGRES relational data base management system in a DEC MicroVax environment. The EPMIS program which interfaces with this data operates at an extremely slow speed. In addition, documentation defining the structure and relationships within the database is incomplete making it difficult to analyze and improve on its performance. This thesis generates documentation for the EPMIS data base, including an entity-relationship diagram, in order to understand the logical structure of the data base. The EPMIS program is then analyzed to identify processing bottlenecks that degrade system performance. Modifications to the program are made to eliminate the bottlenecks and improve system performance.

THE USE OF A UNIX-BASED WORKSTATION IN THE INFORMATION SYSTEMS LABORATORY

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The Information Systems Laboratory of the Department of Administrative Sciences has installed a UNIX-based workstation for student use. The UNIX operating system, one of the most popular systems available today, is an attempt to provide a powerful operating system that is largely machine-independent. This thesis examines the capabilities and limitations of the UNIX operating system as it pertains to the Information Systems student. It also provides a user's manual for the student, thus allowing them to gain a working knowledge of the system and prepare them to take advantage of its capabilities. The research concludes that, with proper administration the use of UNIX workstations can be very valuable to the Information Systems student.

THE DESIGN OF A LOCAL AREA NETWORK CONFIGURATION MANAGEMENT SYSTEM FOR THE NAVAL POSTGRADUATE SCHOOL ADMINISTRATIVE SCIENCES DEPARTMENT

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The thesis identifies system requirements and provides an application system design for an automated Local Area Network (LAN) Configuration Management System to be used by the Naval Postgraduate School Administrative Science Department LAN Staff. The proposed system will provide a tool to assist the LAN Staff in carrying out maintenance functions such as tracking changes to hardware and software configurations of LANs. Problem definition, requirements definition, and system design are among issues addressed. This system is intended for use on a microcomputer based database management system.

DESIGN AND DEVELOPMENT OF A USER INTERFACE AND USER MANUAL FOR A SYSTEM DYNAMICS MODEL OF SOFTWARE MANAGEMENT

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Simulation models typically possess primitive user interfaces. Users must spend substantial amounts of time learning the model before they gain proficiency in using this model. A versatile, user-friendly interface reduces the time and frustration involved in learning a new system. This research effort designs a user-friendly interface for the System Dynamics Model of Software Project Management. The interface is written in a batch programming language, compatible with the IBM personal microcomputer. The interface is a product of the prototype design approach. A sophisticated batch language provides the self-generating menu structures, advanced string handling capabilities and color enhancements.

CONVERSION OF HARD-COPY DOCUMENTS TO DIGITAL FORMAT UTILIZING OPTICAL SCANNERS AND OPTICAL STORAGE MEDIA

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Storage of hard-copy archival paper documents requires vast amount of storage space and time to search and retrieve. Technology exists today to convert hard-copy texts using optical scanners and storing in a digital formal on optical disks. This thesis conducts an indepth current technology research of optical scanners, optical storage mediums, and optical information systems. Utilizing the thesis documents presently stored in the library aboard Naval Postgraduate School, as a statistical base, this research analyzes the requirements to convert the thesis documents to digital format. This thesis concludes that an image optical information system is a viable alternate to storing hard-copy documents and recommends follow-on thesis research to build an in-house optical system.

THE DESIGN AND DEVELOPMENT OF A GAMING INTERFACE FOR THE SYSTEM DYNAMICS MODEL OF SOFTWARE PROJECT MANAGEMENT

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Software project managers have been plagued in the software development process with an infamous reputation for cost overruns, late deliveries, poor reliability and user dissatisfaction. The Dynamic Model of Software Project Management has been designed to support the management of the software development process. The objective of this thesis is to enhance the user interface to the Dynamic Model of Software Project Management by incorporating Gaming. More specifically, software project managers will be able to stop a simulation of a software development project at different intervals, assess project status, and react by altering project variables in real time. This mirrors the dynamic decision making process that software project managers experience in a real world environment.

WHAT ARE THE BARRIERS TO IMPLEMENTING INFORMATION SYSTEMS AT A FLEET AVIATION SQUADRON

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A study was made to determine what the barriers are to implementing information systems at a fleet aviation squadron. Various squadron personnel were interviewed on-site in order to find out what resources were available at the squadron, how they were being used, and what new applications were desired. Members of the information systems staff of the type commander were interviewed as well. The data was analyzed and eight major barriers were identified. Some of the barriers were under control of the squadron, some were external to the squadron, and some were a blend of both. The findings suggest that those barriers identified as squadron-controlled can be overcome through careful planning, better utilization of on board resources, and establishment of a squadron computer training program. The primary external barrier was the uncertainty of financial resources.

MASTER OF SCIENCE
IN
MANAGEMENT

TRANSFER OF MILITARY TECHNOLOGY TO
DEVELOPING COUNTRIES: THE TURKISH CASE

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There is a switch from a direct arms sales to military technology transfer to produce arms in the name of self-sufficiency. The value of domestic arms production at the beginning of the 1980's was about 500 times higher than that at the beginning of the 1950's. By the early 1980's, more than 50 developing countries were producing weapons. The evidence indicates that Turkey has relatively enough arms production potential. However, there is a technological gap which needs to be closed. Turkey should first follow a "path strategy" to create minimum required technological base by using some form of military technology transfer. Then, in the efforts toward indigenous arms production "engineering strategy" may be applied.

SWIM AND SURVIVAL AT SEA TRAINING:
DOES IT MEET THE NAVY'S NEEDS?

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By virtue of operating in a water environment, the average sailor is exposed to the potential threat of falling or being forced overboard. The Navy requires its sailors to pass a minimum fourth class swim test only at the initial accession points with no follow-on testing or training required. Yet, the MILPERSMAN describes a fourth class swimmer as "a swimmer who needs help." This thesis examined the Navy's swim qualification program to determine the adequacy and consistency of the current training with respect to the Navy's requirements. The approach examined the magnitude of the problem as demonstrated by drowning statistics of Naval personnel and attrition of recruits from bootcamp due to failure to swim qualify. This was followed by an analysis of the current program focusing on program emphasis and implementation. The content of the training across programs, the guidance provided for the training, and the elements of other successful programs were evaluated. Finally, the opinions of experts and model swim and survival programs provided the focus for recommended changes in training policy and implementation.

THE EFFECTS OF DEPARTMENT OF DEFENSE AND
FEDERAL SPENDING UPON STATE ECONOMIC GROWTH

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This thesis evaluates the impact of spending by the Department of Defense and the Federal Government upon the economic growth of the states in which funds are expended. A pooled cross-section and time-series analysis is performed on a data base describing the period 1976-1985 and including the forty-eight contiguous states. Personal income is used as a proxy to measure economic growth. The econometric models are estimated using three separate regression methodologies. Consistent parameter estimates permit the author to conclude that Defense Investment spending is highly associated with economic growth. Defense Expense spending is less highly associated with growth. Federal spending other than for defense or intergovernmental aid to state and local governments exhibits an inconclusive relationship with economic growth.

AN ANALYSIS OF COST SAVINGS FROM THE PROPOSED PRIMUS CLINIC AT PRESIDIO, MONTEREY, CA

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In an effort to control rising hospital costs, the U.S. army has initiated a program to contract out primary care for its beneficiaries in selected areas. The initiative is the Primary Medical Care for the Uniformed Services Program. The U.S. Navy has its own contract initiative called NAVCARE, to save money and increase quality service to their beneficiaries. This thesis examined the potential cost savings in the PRIMUS program at one specific clinic, Presidio of Monterey, CA. Future utilization and costs for this program are estimated and compared to projections of the current military health clinic. Findings for this analysis suggest that, given the different incentives of the two programs, the U.S. Army and Navy may not expect any cost savings from this contract initiative.

AN ASSESSMENT OF INCORPORATING QUANTIFIED CONTRACT ADMINISTRATION FUNCTIONS IN USE AT NAVY FIELD CONTRACTING ACTIVITIES INTO THE NAVY'S PRODUCTIVE UNIT RESOURCING (PUR) SYSTEM

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The primary objective of this thesis was to determine the feasibility of modifying the Productive Unit Resourcing (PUR) model to accurately reflect contract administration function performed at the Navy Field Contracting Activities (NFCAs). Data concerning contract administration functions were collected from NFCAs and analyzed in 3 ways: by the percent of contract affected, the number of labor hours expended per contract, and the percent of the total contract administration workload expended per function. The analysis revealed that NFCAs applied subjective interpretations to the contract administration functions, and did not have a credible historical database form which to gather their data. Large deviation factors between the NFCSs were documented. From the data collected, contract administration functions could not be quantified or standardized. It is currently not feasible to modify the PUR model in a manner that would accurately reflect the contract administration functions performed at NFCAs.

IMPACT OF OFFICE AUTOMATION: AN EMPIRICAL ASSESSMENT

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This study examined the productivity of the Standard Automated Contracting System (SACONS), in a before/after quasi experimental design that measured outputs (workload, quality of service), inputs (size of staff, staff grade structure, usage of over-time) and by product social effects (morale, teamwork, professionalism) using archival data. While workload increased slightly, the quality measure (procurement action lead time) improved over 30% after automation. The result was obtained as the size of the staff decreased. Overtime usage declined as a threat or a source of technologically-induced pathos the SACONS automation removed drudgery from jobs. Nagging workload backlogs were diminished. Morale as indicated inversely by sick leave usage, was boosted by the installation of SACONS. Notice was taken of anecdotal evidence and elaboration of time available to assist co-workers strengthened work team cohesion. Time available for training contributed to professionalism. Both factors heightened work self-esteem.

AN ASSESSMENT OF THE POLITICAL AND SOCIAL FEASIBILITY OF PEACETIME TIME DRAFT

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What is the political feasibility of a peacetime draft? Throughout this nations history, the military manning debase has focused upon two separate schools of thought. On the one hand, there are those who believe that a "professional" force, comprised of experienced, career military personnel, is needed for national defense. At the same time others have argued that a force composed of armed citizens is the best expression of democratic, "citizen-soldier" ideals. A return to conscription has been proposed as the best means of remedying the deficiencies resulting from a market-based recruiting system. However, the fact is the Americans are quite satisfied with the current system (according to a 1984 survey). This thesis seeks to place the draft revival question within the framework of the philosophical and historical issues that have helped to shape the nation's attitudes toward military service. A major conclusion of the study is that political acceptability of a peacetime draft in the United States is highly questionable.

QUALITY ASSURANCE IN DOD PERSONAL PROPERTY MOVEMENT: CARRIER EVALUATION AND CONTROL

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This thesis discusses the history, development, and current status of the Carrier Evaluation and Reporting System (CERS). The Carrier Evaluation and Reporting System is the primary quality assurance system used by Department of Defense personal property activities to evaluate and monitor the performance of domestic personal property carriers. Deficiencies in past and current CERS programs are identified and recommendations are provided for improving the CERS program in use today. Several alternative systems are proposed which if implemented will assist DOD personal property managers in making selection decisions for the personal property carrier that will provide the best possible service to the military member.

MANAGING TO PAYROLL AND THE NAVAL POSTGRADUATE SCHOOL PUBLIC WORKS DEPARTMENT

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The Managing to Payroll program was implemented in October 1987. The program is intended to improve the control of Navy civilian personnel costs. The program is also intended to give Navy line managers the ability to tailor civilian work force structures to payroll budget control numbers. This thesis is about the US Navy Managing to Payroll program and how is has affected the payroll budget execution process of the Naval Postgraduate School public Works Department. The program has improved the control of Public Works Department civilian personnel costs. The program has not given the Public Works Department the ability to tailor its civilian work force structure to payroll budget control numbers.

CIVILIANIZATION OF MARINE CORPS BILLETS: A METHODOLOGY

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The purpose of this thesis was to develop a methodology for investigating whether it is feasible and cost effective to transition military billets on board a typical Marine Corps Base to civilian personnel. The methodology is broken down into two phases. The first phase--billet identification procedure establishes a "Combat Essential" criterion used for determining whether a billet is eligible for further civilianization analysis. To be eligible,a billet must not contain any of the seven characteristics that are associated with the "Combat Essential" criterion. After all eligible billets are identified, in the second phase the military cost factors along with the appropriate civilian cost factors are then compared and recommendations for or against civilianization are made. Phase one described above was applied to the Fleet Assistance Program (FAP) on board Camp Pendleton, CA and Phase Two was applied specifically to the Base Clubs System within the FAP.

TOWARD AN OPTAR ALLOCATION MODEL FOR SURFACE SHIPS OF THE PACIFIC FLEET

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This thesis examines the OPTAR allocation process utilized by the Commander Naval Forces, U.S. Pacific Fleet comptroller. The objective of this thesis is to develop a useable OPTAR forecasting model to assist the comptroller in effectively allocating funds to the fleet. The OPTAR grant data of Newport class LST's and Spruance class destroyers were studied to identify the relationship between OPTAR spending patterns of surface ships and their operating schedules. An OPTAR allocation model was developed for each class of ships. The models utilize critical events in a ships employment schedule to forecast quarterly requirements. The models were designed to be easily and effectively implemented by the comptroller and his staff to assist in the allocation process.

WHY STOCHSTIC MODELING IS ESSENTIAL IN ANALYZING INTERDICTED TRANSPORTATION NETWORK PERFORMANCE

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In this thesis, we use simulation to study the probablistic dynamics of a road transportation network when the network is subjected to interdiction by aircraft. We consider several road interdiction schemes. The simulation results are compared to those obtained by using deterministic expected value optimization techniques. This latter approach as been used by other researchers in studies of interdictions of networks. We demonstrate, through the use of two realistic military examples, that the deterministic results poorly predict the performance of the stochastic systems and that the bias incurred by using deterministic methods is significant. Therefore, the stochastic model should be used in real situation.

EFFECT ANALYSIS OF U.S. MILITARY AID TO THE REPUBLIC OF KOREA

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During the last forty years, the U.S. and Korea have maintained a close and friendly relationship. Especially on the military side, the U.S. has dedicated much to Korean military development. The U.S. has also played the role of constrainer to keep North Korea from attacking South Korea. On the other hand, because of Korean economic development and improvement of its self defense capacity, that relationship has begun to change. Through this paper, we will show that changing procedures of U.S. policy in aid to Korea, including military support. Also, even through very few people think negatively about the U.S./Korean relationship, we will describe the need for continued U.S. assistance to Korea; how it is in the interest of both countries to work together and to review what the U.S. has done for Korea, how they changed, and what the future problem is most likely to be.

AN EVALUATION OF COMPETITIVE PROCUREMENT METHODOLOGIES APPLICABLE TO THE ADVANCED ASSAULT AMPHIBIAN VEHICLE

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This thesis investigates the types of competition that exist during the different acquisition phases of a weapon system procurement, and discusses the possible effects that competition has on the acquisition cost of these systems. Also, economic technical, and management variables are presented and discussed that may have a significant impact when considering whether to introduce production competition into a program. Five second sourcing methodologies are presented and discussed with their relative advantages and disadvantages, and a model is presented between the five second souring methods. The proposed acquisition strategy for the Advanced Assault Amphibian Vehicle (AAAV) is performed, with accompanying economic analysis, which indicates that a Contractor Teaming strategy would be appropriate for introducing production competition should the decision be made to second source.

POSITIVE PROPENSITY AND NAVY ENLISTMENT
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This thesis examines the process used to estimate the military enlistment behavior of young men and seeks to develop measures to improve the process. Enlistment intention is quantified through the construction of two separate propensity measures, the percent positive propensity (PPP) and the Navy propensity index (NPI). These measures are included as explanatory variables in Navy and this model is in turn regressed upon net enlistment contract data. The study compares model performance and forecasting accuracy with and without each of the propensity variables, and examines positive enlistment propensity itself at the regional and local levels. The main conclusions of the study are: 1) Weighted propensity should be the value of choice when using YATS II data to estimate propensity measures. 2) Net contract data should be the preferred form of use in forecasting enlistments. 3)There has been a definite decrease in nationwide positive propensity during the period 1983-1987. 4) There is significant regional variation in the predictive accuracy of the current Navy enlistment model. 5) Residual analysis of positive popensity is explained by other significant explanatory variable especially local unemployment. The degree to which other factors explain propensity reduces its effectiveness as an explanatory variable in enlistment forecasting models.

A PRELIMINARY STUDY OF NAVY RECRUITERS: INCENTIVE PROGRAMS AND THE EFFECTS OF JOB-RELATED STRESS
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This thesis focuses on two issues of importance to Navy recruiting: 1) the strengths and weaknesses of the Navy's primary recruiter incentive program, the Freeman Plan, and 2) the possible effects of job-related stress on recruiters. A literature review provided some background information on employee incentive programs, quality of life, and stress. The results of interviews with field recruiters Chief Recruiters, and Enlistment Programs Officers are examined to see how these individuals assess the problems of recruiting. In addition, survey responses from Navy psychiatrists and psychologists are reviewed for information on the number of recruiters seeking assistance for stress-related illnesses, common diagnoses, and the impressions of specialists concerning the relationship between stress and recruiting. This research suggests that the Freeman Plan does not work for all recruiters and should be modified to account for difference in recruiting and difference between various recruiting markets. The study results also indicate a need for stress management training for recruiters.

THE NAVAL AIRCRAFT COMPONENT MODIFICATION PROGRAM--PROBLEMS AND RECOMMENDATIONS

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Lack of strong central direction and inconsistent policy execution by all levels have led to a number of problems in the implementation of component modifications in Navy aircraft. The problems dealt with in this study are confined to the areas of replacement procedures for installed components, implementation schedule, inventory support (spares, piece parts), and modification funding. The results of these problems have been excessive disruption of aircraft readiness and inefficient use of resources. Recommendations are proposed to improve component replacement procedures, retain some standardization during the change process, improve spares inventory support, and clarify funding responsibilities.

MEASURING LOSSES OF LEARNING DUE TO BREAKS IN PRODUCTION

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The analysis of a break in production is usually performed by a government negotiator or cost analyst. The more effectively they are able to estimate the loss of learning due to breaks in production, the more likely that the final contract will be fair and reasonable. The research of this study focused on identifying the factors which contribute to a loss of learning due to a break in production and the methods which are available to quantify these factors. The four methods identified were the George Anderlohr, the DCAA, the Pinchone and Richardson, and the Cubic Curve. These methods were then analyzed using the data from two aircraft, the Grumman C2A and the Bell Helicopter Textron AH-1W, both of which experienced breaks in production. This study concludes that the George Anderlohr approach is the most effective method to evaluate the loss of learning due to a break in production.

AN ASSESSMENT OF THE NAVY'S PRODUCTIVE UNIT RESOURCING (PUR) SYSTEM IN USE AT NAVY FIELD CONTRACT ACTIVITIES

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The primary objective of this thesis was to critically assess the Productive Unit Resourcing (PUR) system as it is outlined in NAVSUP INSTRUCTION 7000.21A and as it is being used at Navy Field Contracting Activities (NFCAs). The research was conducted by a review of current literature and extensive interviews with headquarters and field activity personnel. The research contains a review of PUR's predecessor system, the fixed workyear-cost funding methodology, and explanation of the PUR process and Procurement Cost Center algorithms, and summaries of the positive and negative impacts of PUR. Conclusions and recommendations are made concerning PUR's applicability to Navy Field Contracting Activities. Where specific problems were identified with either the process or algorithms, possible corrective actions are proposed.

REENLISTMENT BEHAVIOR OF FIRST AND SECOND
TERM MARINE CORPS ENLISTED PERSONNEL

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This thesis investigates the reenlistment behavior of first-term and second-term enlisted Marines. The data set consists of Marines who have less than two years remaining on their enlistment contract and is divided into subsets to measure behavior differences between first and second term Marines and also between combat arms and non-combat arms occupational fields. Actual reenlistment behavior combined with survey data from the "1985 Survey of Officer and Enlisted Personnel" are used to measure the importance of individual attitudes towards various aspects of military life on the reenlistment behavior. The analysis is completed by using a logic, maximum-likelihood estimation technique which calculates the probability that a Marine will reenlist given his set of specific characteristics. This thesis also measures the validity of using an individuals stated intention to reenlistment as a surrogate for actual reenlistment behavior. The results confirm previous research in this area and identify potential changes in the reenlistment behavior of women.

PROPOSAL TO CHANGE THE FEDERAL ACQUISITION REGULATION:
RECOGNIZING THE AWARD FEE INCENTIVE IN FIXED PRICE CONTRACTS

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The award fee is a unique incentive structure that provides the Government with a method of subjective, after the fact, evaluation of contractor performance and affords the Government additional flexibility to reward a contractor for above average performance. Additionally, the award fee incentive is subject to the Disputes clause of a contract. Use of the award fee has proven to enhance Government to contractor communication and improve contractor performance in areas of quality, production management, ingenuity, timeliness, and cost-effectiveness. The award fee incentive is recognized in the Federal Acquisition Regulation only under cost reimbursement contracts. limiting the use of the award fee to cost-reimbursement contracts restricts the Government's ability to derive the full benefits of the award fee incentive. In order to obtain the full benefit of the award fee, its use in fixed-price contracts should be sanctioned by recognizing it as specific contract forms in both Fixed-price and Cost-reimbursement contracting.

OPERATIONS AND MAINTENANCE COST FOR NEW MAJOR U.S. COAST
GUARD PLATFORMS PROJECTED: VERSUS ACTUAL COSTS

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This thesis examines the accuracy of the operations and maintenance budget models developed for new U.S. Coast Guard cutters and aircraft as part of life cycle cost analysis prior to acquisition. The HU-25A medium range search aircraft and HH-65A short range recovery aircraft were used along with the 270 foot medium endurance cutter and the 110 foot patrol boat. A regression method of estimating these costs using historical costs were explored as an alternative to the laborious task of identifying each major cost element. The results indicated that the budget models are poor predictor and that the parametric methods may provide more accuracy. Additional research in developing cost estimating relationships for this purpose is needed.

SLOWDOWN IN SOVIET DEFENSE EXPENDITURES: VARIATIONS OF A SUGGESTED MODEL

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This thesis examined existing models that attempt to explain the decrease in the growth of Soviet defense expenditures. Two new models were also developed. The first used the mean of a high and low estimated dependent variable in the existing models, and the second added a different independent variable to the models. Likelihood ratios, chi-squared tests, and Chow tests were used in the regression models to show a mid-70's change in Soviet leaders attitudes toward defense needs. The major conclusion of this study was that there was a definite break in the regression that indicated a change in Soviet defense policy. When all the variables were used, the models exhibited a post-break increase in the growth of Soviet defense expenditures instead of the expected decrease.

BUDGETING UNDER CRITICAL MASS FOR THE NAVY: AN APPROACH TO PLANNING FOR A STEADY STATE DEFENSE BUDGET

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In a time when defense spending is under close scrutiny, each command faces a potential shortage of funding. There is, in theory, a level of resources, called the critical mass of core resources, below which a command cannot continue to fulfill stated mission objectives. This thesis develops a critical mass/core resource model for use in Navy budgeting and applied the model to the Naval Auxiliary Landing Field, Crow Landing, CA. The model may be more useful than the current incremental approaches in the formulation, negotiation, and execution phases of budgeting. The Model provides a framework that may strengthen and protect the command from priorities imposed by outside forces, or, more likely, will permit commands to identify mission opportunity costs or losses resulting from budget cuts. The critical mass model may be superior to current budget formats in the execution phase resources are formally allocated based on mission priority.

ECONOMIC AND POLICY IMPLICATIONS OF PROPOSED ARMS SALES OR TRANSFERS TO THE PERSIAN GULF

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Presidents Carter and Reagan each established a new United States policy to govern sales or transfer of conventional arms to foreign nations. President Carter called for stricter controls and an overall reduction in arms transfers to foreign nations. President Regan believed that arms transfers to friends and allies strengthened to the United States position in the world. This thesis analyzes the success of both arms transfer policies in the Persian Gulf by comparing the dollar amount and type of equipment actually transferred against the formal Congressional Notifications (Arms Export Control Act section 36b). Further it will examine proposed arms sales and transfer with respect to strategic access of the Persian Gulf. Finally, it examines the employment and financial impacts of the Foreign Military Sales program on the United States economy.

TRENDS IN THE ENLISTED FORCE OF THE U.S. MILITARY SERVICES 1974-1987

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This thesis examine the movement of personnel into, through, and out of the enlisted forces of the U.S. military services during the period FY1974-FY1987. The vehicle for this analysis is the Enlisted Transition Matrix, which is used by DOD and the Office of Management and Budget (OMB), to track the transition characteristics of the enlisted forces. The matrix data were supplied by the Defense department aggregated to the service-wide and years-of-service (YOS) level. The main conclusion of this thesis is that analysis of data aggregated to this level does not yield useful information. Economic and demographic factors fluctuated significantly during the period of interest; however, the effects of those fluctuations are not evidenced in enlisted force information aggregated to the force or YOS level.

ONE-YEAR UDP: A COST/BENEFIT ANALYSIS OF A PROPOSED ALTERNATIVE TO THE MARINE CORPS' UNIT DEPLOYMENT PROGRAM FOR FIGHTER AVIATION

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The author examines the incremental costs and benefits associated with a change from six-month unit deployments to one-year unit deployments. The analysis is based primarily on five fighter squadrons participating in the Marine Corps Unit Deployment Program and takes in the period July 1976 to October 1988. Regression analysis is used to project trans-portation cost savings of $4 million in real terms from FY1989 through FY1993. With a change to a one-year Unit Deployment Program, fighter squadrons should experience net increases in aircraft readiness, aircrew training readiness and personnel retention.

THE ROLE OF THE NAVY ADMINISTRATIVE CONTRACTING OFFICER IN IMPLEMENTING THE SUBCONTRACTING PROVISIONS OF PUBLIC LAWS 99-61 AND 100-180

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Public Law 99-661 established a five percent goal for all Department of Defense (DOD) contracts to be awarded to small disadvantaged businesses (SDBs). Public Law 100-180 extended this goal to include large subcontracts under DOD prime contract. This study was undertaken to assess the role of Navy Administrative Contracting Officers (ACO's) in implementing these laws. The results of this study: Senior personnel throughout DOD have not fully understood the Strong Congressional support this program enjoys. The five percent goal for subcontracting with SDB's is seen as unrealistic by ACO's. The sole source nature of much of the work performed at the activities evaluated limits the actions available to an ACO. There was no statistically significant increase in the level of subcontracting with SDB's between Fiscal Years 1987 and 1988 or between those activities that evaluate ACO's in this area and those that don't.

AVIATION DEPOT LEVEL REPAIRABLE MANAGEMENT AND ACCOUNTING PROCEDURES AMONG NAVAL RESERVE AIR SQUADRONS AT NAS ALAMEDA, NAS MIRAMAR, NAS MOFETT FIELD AND NAS WHIDBEY ISLAND

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This thesis reviews existing tracking practices of Aviation Depo Level Repairables (AV-DLRs) among selected Naval Air Reserve Squadrons on the West coast. It examines the interface between carcass tracking and financial management of AV-DLRs among Aviation Supply Deports and Naval Reserve Comptrollers. It appears that significant improvements have been realized in AV-DLR tracking since AV-DLRs migrated from the Appropriations Purchase Account to the Navy Stock Fund on 1 April, 1985. It is evident that a clear line of communication must be established and maintained between the carcass tracking function and the financial accounting function at the Reserve Comptroller level so that better management decisions may be made. It is equally clear that the XR86 Program and NALCOMIS are effective adjuncts in the management of AV-DLRs. A concerted effort should be directed toward implementing these management tools in areas where they are not being utilized.

A META-ANALYSIS OF INSTITUTIONAL THEORIES

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This paper assesses the implications that institutional theories have for resource management in organizations, and specifically for the resource management in non-profit organizations. A meta-analysis of research studies that apply institutional theories is conducted in this study. Various dimensions, not mentioned in the theories, are discovered and analyzed in light of the theories. Assessments are made as to whether or not the various aspects of theory are appropriately operationalized through the discovered dimensions. The general conclusion is that theories are appropriately operationalized, but there are problems with the treatment of unit of analysis. Recommendations based on analysis are given for subsequent research which may further clarify applications of institutional theories.

TIME FACTORS AFFECTING THE RETENTION DECISION OF NAVY ENLISTED MEMBERS

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and
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The purpose of this thesis is to determine how time affects the factors that influence the retention decision of Navy enlisted members. The empirical analysis utilizes two different samples, the first composed of enlisted members and the second of members and their spouses. What differentiates this study from other retention studies is the stratifications of the samples before conducting the analysis. Multivariate analysis was used to determine the change in the probability of reenlistment and the significance of identified variables. Results show that member's intentions are a good predictor of reenlistment behavior, and that the impact of each factor affecting the reenlistment decision changes, depending on the member's gender, time to EAOS and enlistment term. Spouse and family factors were also found to affect the member's reenlistment decision. This information assists in developing an understanding of the factors that are important to service members, which should facilitate policies to increase retention of Navy enlisted members.

FINANCIAL CONDITION OF GOVERNMENT CONTRACTORS AND CONTROL OF PRODUCTION COSTS IN THE PROCUREMENT OF MAJOR DOD AIRCRAFT WEAPON SYSTEMS

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This thesis identifies conditions associated with production cost overruns or underruns on major weapon systems. The analysis used U.S. military fighter/attack aircraft. First, relying on techniques developed in prior studies, measures of the technology embodied in aircraft and the cost of producing those aircraft were developed. Next, relationships between technology and cost were examined to create measures of "should costs," for each aircraft based on technology in the aircraft. These estimates of "should costs" were compared to actual costs to determine situations of cost overruns and underruns. Analysis of financial ratios of each aircraft's prime contractor were used to determine if financial condition could explain the cost overruns or underruns experienced during production, by using several forms of regression analysis. This yielded models relating financial ratio to cost overruns or underruns. Major findings indicate that financial condition does partially explain production cost overruns and underruns, but the relationship is small.

THE TQM COORDINATOR AS CHANGE AGENT IN IMPLEMENTING TOTAL QUALITY MANAGEMENT

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The implementation of Total Quality Management involves a major change, a paradigm shift, in management philosophy. Implementing TQM requires the use of a change agent to act as a catalyst to change the organization. Interviews with TQM coordinators, and a survey of 143 organizations were done to examine to role of the TQM coordinator. Research identified criteria for selection, and location in the organizational structure. Use of an external consultant in a team concept is examined. Resistance to change and overcoming that resistance are explored. Ways to measure success are discussed.

AUDITING GOVERNMENT TRANSPORTATION BILLS

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This thesis examines the area of transportation bill auditing in the Federal Government. It reviews the history of transportation bill auditing, the mechanics of auditing freight transportation bills, and the various factors that impact on the causes and identification of overcharges. This thesis analyzes the current method of post-payment audits of all government transportation bills by GSA and reviews the ongoing initiatives by DOD to implement pre-payment auditing. It concludes that DOD is paying upwards of $48 million a year in freight overcharges alone and that pre-payment audits can significantly reduce this amount.

FACTORS INFLUENCING THE JOB SUCCESS OF WOMEN COLLEGE GRADUATES

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This thesis examines the effects of personal, job related, and college characteristics on the job success of women college graduate employed by a major U.S. manufacturing firm. Job success was defined in terms of performance evaluations, wage growth, and promotion rate models. The relative success of graduates of women's colleges were compared to graduates of coeducational institutions. Ordinary Least Squares analysis was used to evaluate the data. Empirical results indicate that performance evaluations were positively influenced by salary grade, various college majors, and attendance at a women's college. Conversely, the number of women faculty at the college attended adversely affected performance. The results of the promotion rate model show that performance evaluations reduce the time to promotion. Finally, the wage growth model illustrated the positive effects that marriage and education have on job success.

RETENTION BEHAVIOR OF DRAFTEES AND VOLUNTEERS

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Experts believe that draft would require a larger number of accessions, since draftees and draft-motivated volunteers are more likely to leave military service than volunteers at their first opportunity. This thesis presents advice on this issue. We are able to compare retention behavior and service lengths of draftees and volunteers in the same cohort by using data files consisting of enlistees during lottery draft years.

THE BALANCE OF THE ROK AND NORTH KOREAN GROUND FORCES
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Since the ROK and the North Korea stand face to face in the Korean Peninsula, there has been constant concern about the risk of war. In this situation, prevention of war on the Korean Peninsula is much more important than anything else. It is feasible when the balance of conventional military forces is kept. The purposes of this thesis are to compare each sides ground forces as a major military strength, to develop the ROK ground force structure planning for ground force balance of the ROK against North Korea, to identify the important factors for reinforcement of ground forces in wartime, and to present the combat models considered for the Korean Peninsula. In addition to those, it proposes the U.S. presence in Korea and the improvement of early-warning capabilities.

DEBRIEFING PROCESS FOR THE MAINTENANCE SECTIONS OF THE ISRAELI AIR FORCE FIGHTER SQUADRONS
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The objective of this thesis is to suggest a daily routine debriefing process for the maintenance sections of the Israeli Air Force fighter squadrons. It is argued that the debriefing process may serve as vehicle for higher level of personal and organizational effectiveness. Ongoing debriefing process in one squadron, has been assessed, opinion data have been collected, and relevant literature has been reviewed. The questions addressed in this study are: 1) what is the role of debriefing process in the in the mainten- nance sections: 2) what is the debriefing structure forums, frequency, and discussion subjects: 3) what are the attitudes of targeted sectors toward the suggested procedure, and 4) what are the organizational changes and concerns to be considered when implementing this change. Results have indicated strong positive attitudes, cost-beneficial appearance, and practicality of the proposed debriefing process. Guidelines for implementation are provided.

CHARACTERISTICS AND EFFECTS OF RELATIONSHIPS INVOLVING FEDERAL GOVERNMENT CONTRACTING OFFICERS
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The role of the contracting officer has evolved through our nation's history from one of simply an intermediary between supplier and consumer to that of a sophisticated manager of requirements and resources. In the execution of his many and varied duties and responsibilities, the present-day contract officer must interact with a variety of individuals and organizations. This report attempts to identify these various relationships, to analyze their characteristics, and to determine how each affects the contracting officers accomplishment of his primary tasks and responsibilities. The researcher proposes a model of the contracting officer's environment and identifies ten relationships involving the contracting officer which appear to predominate in this environment. The 1969 procurement tasks compiled by Fowler from previous research are analyzed in the context of these relationships. The researcher concludes by revising the proposed model and suggesting that it be further refined by subsequent field validation.

ESTIMATING THE RELATIONSHIPS BETWEEN THE STATE OF THE ART OF TECHNOLOGY AND PRODUCTION COST FOR U.S. AIRCRAFT

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Advisor: O. D. Moses - Department of Administrative Sciences

The primary objective of this study is to determine relationships that exist between production cost and the state of the art of technology and extensions in technology for high-technology and systems. The data sample selected for study was U.S. military aircraft. The central methodology used in the analysis of the aircraft data base included: 1)The development of measures for the state of the art of technology and the level of technology advance that exists within U.S. fighter and attack aircraft programs. 2) The development of measures for each aircraft program's production cost. 3) The application of various statistical procedures (regression analysis) to test specific hypotheses and build models to explain the relationships between technology and cost . General conclusions from this study are that significant relationships do in fact exist between aircraft production cost and specific technology measures.

ARMED FORCES AND NATIONAL DEVELOPMENT IN KOREA

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During the last thirty years, Korean society has experienced a significant increase in the role, influence, responsibility and expertise of the military. The role and contribution of the military has been extensive for the nation-building of the newly independent country, the maintenance of national security economic and social development, and to cultivation of nationalism spirit. Even though the military is composed of all strata of society and contains the same ideology and values as the civilian population, there still exists a communication and understanding gap between the military and civilian population. In order to decrease this gap and enhance mutual understanding, the military must take active effort to improve public relations through an increasing awareness of what the military does in Korea, and how it supports civilian population activities.

MANAGEMENT GUIDE FOR FIELD ACTIVITY COMPTROLLERS

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The focus of this thesis is to identify the important functions and responsibilities performed by field activity comptroller department from the preponderance of Navy financial management directives, manuals guide which addresses each of these functions and responsibilities through a series of questions and statements. The resulting management guide will be included in the Practical Comptrollership Course (PCC) offered by the Naval Postgraduate School in Monterey, CA., and is primarily intended for use by PCC students when relieving filed activity comptrollers or as a routine management tool.

LABOR RESOURCE AUDIT AND ANALYSIS: A TOOL FOR MANAGEMENT PLANNING AND CONTROL

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This study was conducted in an effort to develop improved techniques for labor resource analysis and reporting to enhance workload management and planning. A labor resource audit is described that is sufficiently flexible and adaptable to all Navy public works activities. This thesis presents a step-by-step method to analyze, design and implement a prototype labor auditing system for determining and budgeting for proper level, mix, and balance of personnel to support maintenance and repair operations.

Specifically, this thesis focused on workload growth, backlog completion time, personnel and funding shortfalls in the area of real property maintenance and repair at the Naval Postgraduate School. Information developed provided insight into: effectively identifying resources to decrease backlog; managing incoming work requests more effectively; and providing financial accountability and credibility at middle management levels.

INVENTORY MANAGERS FOR THE AVIATION SUPPLY OFFICE

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Each inventory manager at the Aviation Supply Office Philadelphia, PA is presently required to manage approximately 700 line items. To allow the inventory manager a more efficient method of reviewing and using the data reports from the Uniform Inventory Control Point (UICP) computer system, a distributed computer system is necessary. By downloading the appropriate inventory data from UICP to a local computer system, a decision support system (DSS) can be implemented using existing off the shelf hardware and software. The ability to replace the present copious paper reports with concise computerized information and import that data into electronic spreadsheets for further analysis can greatly

improve the inventory manager's effectiveness. To this end, this thesis provides inventory managers at ASO with access to the following functions: *Interactive access to the main UICP database. *The ability to use UICP data with a decision support system. *A user interface that is easy to understand and learn. *A local data base which supports working group requirements. *Basic office automation. This thesis will cover the selection of the hardware and software, data identification and management and DSS development. A prototype system call the IM Workstation was developed for this thesis and used to produce the thesis document. COBOL and ALIS ELF macro program lisitings are provided.

PROGRAM BUDGETING WITHIN THE DEPARTMENT OF THE NAVY

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This thesis examines the Department of the Navy's budgetary process. It describes how the budgetary process works and analyzes the actions of the budget reviewing authorities. The Operations and Maintenance (O&MN), budgets submitted by the Major Claimants are examined to determine budget strategies and their effects on the reviewing process. The database used the O&MN, FY1990 records form the Comptroller of the Navy's (NAVCOMPT) office. This analysis found that: Claimants who requested small (0-4.9 percent), increases, were the most

successful at gaining budget increases. The most successful strategy was to minimize the initial NAVCOMPT cut, and aggressively use the reclaim process to restore cuts. This appears to have been achieved through a strategy of aggressive line item justification. The OSD OMB review was essentially a mechanical, across the board cut, which was modest in size. Most of the review adjustments were pricing changes, or reflected program changes. Some of the Major Claimants are consistently better than others at achieving budgetary success.

PERFORMANCE MEASUREMENT IN THE RAMP SMP FACILITY

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The Rapid Acquisition of Manufactured Part (RAMP) program is a Navy initiative to address the problems of high cost, growing leadtime and diminishing sources for spare parts. RAMP addresses this by developing digital parts technical data and computer integrated manufacturing (CIM) capability within the Navy and integrating this capability into the Navy's supply and weapons acquisition system. Management will require timely, accurate cost and operational data to evaluate the efficiency of the RAMP facility and its effectiveness in achieving program goals. Traditional accounting and performance measurement systems produce inadequate data in a CIM environment. This thesis derives objectives for the facility from program goals and proposes measurements to assess the achievement of these. The measurements emphasize flexibility, quality, efficiency and support of RAMP program goals.

AN ASSESSMENT OF RELEVANT COSTS IN THE WILSON EOQ MODEL

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This thesis presents a framework for determining ordering and holding costs as parameters in Economic Order Quantity (EOQ) type inventory models. The concept of relevant costs is discussed from a theoretical perspective. Regression analysis was used to compare annual ordering cost and the number of orders at Ships Parts Control Center (SPCC), Mechanicsburg. The relationship was found to be inverse over the years 1976-1988. This indicates that a critical assumption for the use of EOQ models is being violated at SPCC. Various probability distributions were used to simulate how total variable cost was affected by changes in the holding cost parameter. The results indicate that the feasibility of applying different holding cost rates for various items should be further explored.

THE IMPACT OF ACCOUNTING METHODS ON COST REDUCTION RATES IN DEFENSE AERO-SPACE WEAPONS SYSTEM PROGRAMS

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This study investigates the relationship between accounting and cost reduction rates exhibited in Department of Defense aerospace weapons system programs. The role of three accounting methods (depreciation inventory, and investment tax credit) in predicting cost reduction rates are studied. Of the three accounting variables, only inventory was consistently associated with program cost reduction rate behavior at a statistically significant level. This finding suggests that in some contexts accounting methods may explain cost reductions slopes. But, the findings were contrary to the expected association between accounting methods and cost reduction, so a full explanation of how accounting methods are related to cost reduction awaits further research.

LIFE CYCLE COSTING TO IMPROVE DECISION MAKING IN THE BUDGET PROCESS

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The objective of this research is to examine the obstacles which are preventing the Marine Corps from realizing the full economic advantage of using total life cycle costing to improve decision making in the budget process. The research has shown that the current budget process does not provide the means necessary to encourage the development of innovative support concepts nor does it provide a process necessary to take advantage of these concepts. A system needs to be established to provide a more stable acquisition and budget environment for the development and procurement of ground combat weapons systems. Finally, budget reform should be accomplished so that life cycle costing can support a system to minimize cost and cost risk, maximize management control, and ultimately deliver weapon systems to our combat forces which are operationally effective, affordable and logistically supportable.

DOMESTIC PRODUCTION AND NATIONAL SECURITY--IS THERE A CONNECTION? A CASE STUDY OF SEMATECH RESEARCH CONSORTIUM

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This thesis examines the relationship between domestic industrial production and national security as they relate to strategically-vital defense products. An analysis of the semiconductor research and development consortium, SEMATECH is conducted to determine the viability of this type of organization to bolster domestic semiconductor manufacturing. The objective of this thesis is to determine the need, if any, for increased Federal Government support of research consortia in encouraging domestic manufacturing capability of vital defense products.

WHAT ARE THE PRINCIPLE DEFICIENCIES INVOLVED IN THE MANAGEMENT OF GOVERNMENT FURNISHED PROPERTY AND HOW MIGHT THESE DEFICIENCIES BE CORRECTED

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This thesis assesses the principal deficiencies in the management of Government furnished property (GFP). The Department of Defense (DOD) policy of providing Government property to contractors has been under constant Congressional review. The thesis presents a brief history, benefits, and some of the many Government Accounting Office and DOD agency audit reviews concerning GFP. Data were collected form the six Defense Contract Administration Services Plant Representative Offices (DCASPROs) in the Los Angeles region. Collected data indicated that there are nine principal deficiencies in the management of GFP. They are: maintaining trained staff personnel, contracts, inaccurate record keeping, inadequate dispositioning of GFP, lack of GFP warranty procedures, lack of contract preaward and postaward involvement of Property Administrators, personnel shortage, GS grade level parity, insufficient upper-management support from contractor, and inadequate GFP storage. The study concluded that the single most important requirement for success in a Government property management system is a strong and honest working relationship with open communication between the Government's and contractors Property Administrators.

RESOLVING INADEQUACIES OF THE NAVY INDUSTRIAL FUND COST ACCOUNTING SYSTEM TO ENABLE ITS USE IN THE RAMP SMP FACILITY

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The Navy is constructing an automated manufacturing facility which incorporates flexible manufacturing systems (FMS) and computer integrated manufacturing (CIM). The facility, which is known as the RAMP SMP facility, will operate within the Navy Industrial Fund (NIF) system. Previous research concluded that several elements of the NIF cost accounting system were inadequate for use in the RAMP facility. Inadequate areas included direct and indirect cost definitions, indirect cost allocations, and performance measures. This thesis identifies resolu-tions to the inadequacies of the NIF cost accounting system for use in the RAMP facility. A model was developed, presented, and adapated to the NIF cost accounting system. The model focuses on redefining direct and costs and cost centers, developing appropriate multiple indirect cost allocation bases, and expanding performance measures to include operational performance measures. The author concluded that these changes were minimal yet essential so the NIF cost accounting system will be adequate for use in the RAMP facility.

VALIDITY OF EMPIRICAL STUDIES OF INFORMATION SYSTEMS EFFECTIVENESS

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This thesis reviewed 45 studies that purported to empirically assess the effectiveness of information systems. They were evaluated for a) vulnerability to alternative explanations of reported finding, b) effect of data collection methods upon their conclusions, c) capacity to establish casual inference, d) how they defined system success and e) reported changes in organizations following information system implementation of information systems. This deficiency is worsened by the emergence of antagonistic schools of though among MIS researchers as to how system effectiveness should be evaluated. Recommendations are made for improvements in MIS research designs and data collection techniques. Suggestions are made for ways by which line managers and commanders as well as managers of MIS activities must become informed consumers of MIS academic research on system effectiveness.

ASSESSMENT OF THE NAVAL FACILITIES ENGINEERING COMMANDS'S INVESTMENTS IN RESEARCH AND DEVELOPMENT

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The Naval Facilities Engineering Command, like all other major commands within the Department of Defense, is interested in the cost effective utilization of their limited research and development investments. Assessments of NAVFAC'S RDT&E results conducted in 1968 and 1980 established baselines for determining where improvements are needed. This study uses the results of a mail questionnaire, sent to military and civilian personnel at "NAVFAC family" activities worldwide, to provide a basis for a current assessment of how effectively NAVFAC'S RDT&E investments are being utilized. This current assessment is used to make comparison with the previously established baselines, in order to provide a basis for measuring the degree of improvement and to provide information for the development of an RDT&E investment strategy for the 1990's. The results indicate that numerous trends have been continued, progress has been made, and that there are some areas of concern.

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LIBERAL EDUCATION IN THE KOREA AIR FORCE ACADEMY

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This study is an attempt to analyze the current educational programs of Korea Air Force Academy in terms of Liberal Education. The following two research questions are addressed 1) What is the overall structure of Korea Air Force Academy education and training programs? 2) What are the aspect of the current programs with regard to liberal eduction? Principal findings with regard to research questions are presented. Specific recommendations are also proposed as suggestions for an overall plan of organization of the educational program.

THE GRADUATE RECORD EXAMINATION (GRE) AS A PREDICTOR OF SUCCESS AT THE NAVAL POSTGRADUATE SCHOOL: A VALIDATION TEST

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This thesis focuses on the use of the graduate Record Examination and other measure as predictors of academic success at the Naval Postgraduate School It substantially validates the results of a previous study completed last year which showed the Graduate Record Examination to be a much stronger predictor of success than the currently used Academic Profile Code. This thesis also shows that the combination of Graduate Record Examination scores and Academic Profile Code measures is an even stronger predictor of academic success at the Naval Postgraduate School. An updated prediction equation is provided to determine which officers would be most likely to succeed if selected for graduate education at Monterey. The thesis contributes to the NPS's ongoing three year study of the value of the Graduate Record Examination in the School's admissions process.

SPENDING TO SAVE: MODELING THE CLOSURE OF NAS MOFFETT FIELD

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The closure and realignment of surplus military installations represents one method of saving defense dollars. This thesis examine the development of a cost model to define major cost categories and project an estimated payback period for closure and realignment. Costs of base closure, unit relocation, and subsequent return to full mission capability are estimated. Naval Air Station Moffett Field, California, is used as a case study. Data were compiled using local information sources. A comparison between the methodology developed in this study and the cost estimation model used by the Defense Secretary's Commission on Base Realignment and Closure is provided. Conclusions on base closure management issues and directions for future research are listed in the final chapter.

LEADERSHIP THEORY AND PRACTICE: WHERE EAST MEETS WEST

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This thesis is an exposition of what traditions the Chinese people have regarding leader-follower relationships, how they have evolved, why they are able to survive the test of time for so long, and how they may stand the Chinese officers and men in good stead in their exercise of leadership. The thesis is also a study of what Western leadership concepts can be assimilated to good advantage by the Chinese and what additional research efforts for the Armed force of the Republic of China should be undertaken. The thesis also includes a description of the ECHO sampling technique, which was used in the gathering of data for the identification of key leadership factors and traits by Chinese officers studying at U.S. Naval Postgraduate School in Monterey, CA.

A COST/BENEFIT ANALYSIS OF THE SUPPLY MANAGEMENT ASSESSMENT PROGRAM

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This thesis examines some of the effects of implementing the Supply Management Assessment (SMA) program within the Surface Force, U.S. Pacific Fleet. Data were gathered from a survey, interviews and analysis of supply Management Assessment reports. The implementation of the Supply Management Assessment by the Commander, Naval Surface Force, U.S. Pacific Fleet resulted in an overall positive influence on afloat supply management and combat sustainability, particularly in the areas of inventory and configuration management. Research results indicate that benefits derived from enhanced financial and supply management operations which are a direct result of SMA implementation, outweigh the costs of the new program. Because of the potential for improvement in effectiveness of afloat operations, the Supply Management Assessment program should be presented to other type commanders and fleet commanders for evaluation and possible adoption. Based on evaluation of the research data, recommendations are presented for further enhancements to the Supply Management Assessment.

OPERATIONAL EFFICIENCY STUDY OF THE NAVAL POSTGRADUATE SCHOOL GOLF COURSE

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This thesis examines the financial and management control functions associated with the Naval Postgraduate School Golf course in Monterey, CA. A comparison is then made to the financial and management operations of the Fort Ord Gold Course in Fort Ord, CA. to see if a more effective financial management control system can be employed at the Naval Postgraduate School Golf Course. Emphasis will be placed on purchasing, inventory, payroll, and cash procedures. In addition long range planning and guidelines used by the Professional Golf Association and the National Golf Foundation will be discussed.

EXPANSION OF THE EQUIPMENT ALLOWANCE POOL AT TWENTY-NINE PALMS, CALIFORNIA, USING RESERVE ASSETS

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and
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Static marginal analysis is applied to the Marine Corps proposed expansion of the Equipment Allowance Pool at Twenty-nine Palms, CA., using Select Marine Corps Reserve assets. A formula is presented for determining potential equipment candi- dates. The formula combines various weighting factors, equipment use, and savings potential to produce a "keep factor." Assets with low keep factors are selected first. Recommendations for further studies are also made.

FIRST-TERM RETENTION OF ENLISTED SELECTED MARINE CORPS (SMCR) RESERVISTS

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This thesis examines factors that influence a male, first term enlisted reservists decision to remain in the Selected Marine Corps Reserve (SMCR). Specifically, the logistic regression model was used to determine the relative impact of biodemographics and both pecuniary and nonpecuniary job factors on retention. Models were developed for both nonprior (NPS) and prior active service (PS) reservists. The data base was a combination of the responses of participants in the 1986 Reserve Component Surveys and their personnel records from the Reserve Components Common Personnel Data System. The thesis concludes with reserve policy implications and recommendations for further research. Important findings of this thesis were: *Reserve income has a statistically significant and positive impact on SMCR retention. Civilian income was not found to be a factor. *Educational benefits, civilian job-related training, and retirement benefits were found to be significant factors in retaining prior service reservists.

CAUSES OF COST INCREASES INCURRED BY GOVERNMENT CONTRACTORS PERFORMING COAST GUARD COMMERCIAL ACTIVITIES CONTRACT OUT UNDER OMB A-76

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The Office of Management and Budget Circular No. A-76 directs all Federal Executive Agencies to rely on the private sector for goods and services. The United States Coast Guard, an operating agency of the Depart-ment of Transportation, is required to comply with A-76. Many believe that Government contractors performing functions contracted out under A-76 incur excessive cost growth over the life contract. This thesis analyzes three such Coast Guard commercial activities which were contracted out under the Circular. Specifically, it identifies causes of cost increases, and relates the current year contract price with the cost of performing each function in-house.

THE PILOT CONTRACTING ACTIVITIES PROGRAM: A MANAGEMENT REVIEW

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Advisor: E.N. Hart - Department of Administrative Sciences

The Pilot Contracting Activities Program (PCAP) is designed to provide a means for selected Department of Defense activities to submit request for deviation of waiver of Federal and Department of Defense acquisition regulation requirements in order to decrease administrative burden, increase procurement effectiveness and efficiency, and simplify the contract- ing process. This study examines the implementation and management of the PCAP program by the participating activities, the status of the Program in general, offers recommendations for improvement, and analyzes what effect the Program will have on regulatory reform.

DEVELOPING AN INVENTORY MODEL FOR THE KOREAN AIR FORCE REPAIRABLE ITEM INVENTORY

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Master of Science in Management - December 1988
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The Korean Air Force has determined that repairable management is one of the areas in which attention could be expected to lead to substantial improvement in the efficient management of defense resources and in maintaining an adequate level of force effectiveness. This thesis reviews various inventory models for the management of repairable items and develops an inventory model for the Korean Air Force. It discusses the characteristics of each model, and identifies and explains the differences in each model with respect to assumptions, objectives, constraints, and optimization methods. Also, this research evaluates the proposed model using sample data sets.

A MARGINAL ANALYSIS FOR MINIMIZING SHORTAGE IN A MULTI-ITEM INVENTORY SYSTEM WITH A CONSTRAINTS FOR A SINGLE PERIOD

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This thesis addresses the problem of determining the optimal number of spares in a multi-level inventory system with a procurement budget constraint for a specific period. In war time, an expected shortages of spares is an extremely critical factor in the ROK Army's ability to fight. For the initial stage of war, the ROK Army combat units have to reserve the "loading package." The purpose of this thesis is to select the loading package to minimize the expected number of shortages over all the items included subject to a budget constraint. A Marginal Analysis and Dynamic Programming (DP) are considered. Though Marginal Analysis is not strictly optimal, it is very nearly so and much more efficient than DP. Consequently, the Marginal Analysis Approach appears preferable in the military area because it is very simple, flexible, and easy to program.

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AN "EXCELLENT PILOT MODEL" FOR THE KOREAN AIR FORCE

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The Korean Air Force is continuously being challenged with the problem of whether to drop or retain a student who is having difficulties in flight training. The pass or fail decision is critical not only to the Korean Air Force, but also to the student pilot himself. The purpose of this study is to determine and standardize criteria of excellence in order to improve the success of the student pilot screening process.

The following two research questions are addressed: 1) What are the primary factors that predict aviation excellence? 2) How do these factors apply to student pilot screening in the Korean Air Force? The anticipated benefit of this study is the improvement in the screening of undergraduate pilots in the Korean Air Force.

A LEVEL OF REPAIR MODEL FOR THE INDONESIAN NAVY

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This thesis develops a methodology for making level of repair decisions for new, fully developed, weapons systems purchased by the Indonesian Navy from other countries. This model considers the Navy's current maintenance and supply organizations. An example illustrating the use of the model is also presented.

SOCIOECONOMIC DETERMINANTS IMPACTING AIR FORCE OFFICER RETENTION

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This thesis analyzes retention and attrition behavior of Air Force captains with four to 11 years of service, extracted from the 1985 DoD Survey of Officer and Enlisted Personnel. All occupations were examined except medical, dental, nursing, chaplain, and legal professions. Logistic regression models were estimated for all officers data. These models included demographic, attitudinal, and economic data. The results showed that as Air Force captains with four to eleven years of military service gained more experience, they were more likely to leave the military. Total family income was found to have a negative effect on retention. Separate models estimated retention behavior by marital status and gender. Gender and total family debt were significant for married officers. The models contrasting men and women indicated that advanced degree attainment had a negative impact on female retention. The predictive capabilities of the models were evaluated. Recommendations for follow-on studies also discuss limitations of this analysis which may be addressed in future DoD surveys.

SHOULD COST OVERHEAD STUDY ANALYSIS:
AN EXAMINATION OF SELECTED STUDIES
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Master of Science in Management - December 1988
Advisor: D.V. Lamm - Department of Administrative Sciences

Should Cost analysis has become a standard tool for the Government to achieve cost reasonableness in a negotiated contract. Recently, contractors in the Defense Industry have begun to question the effectiveness of this analytical process and the necessity of its use. This thesis examines the Should Cost process, it implementation in the area of overhead cost analysis, and analyzes the effectiveness of three specific Overhead Should Cost studies and the impact of those studies on the contractors.

AN ANALYSIS OF THE PROCUREMENT AND MANAGEMENT
OF END-USER COMPUTING EQUIPMENT (EUCE)
WITHIN THE UNITED STATES MARINE CORPS
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Master of Science in Management - June 1989
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This thesis analyzes the procurement and management of End-User Computing Equipment (EUCE) within the Marine Corps. EUCE refers to microcomputers and peripherals. The background chapter covers microcomputer acquisition in the Federal government, Marine Corps history of EUCE acquisition, regional data processing support, information resources policy formulation within the USMC, and the Mid-Range Information Systems Plan (MRISP). The second chapter covers the current environment and these topics: organizational differences in EUCE procurement, current procurement procedures, Marine Corps EUCE property control, and potential problems in procurement and management. The third chapter presents the results of a survey of 11 contracting offices and 26 ADP offices, and the final chapter gives the conclusions and recommendations. Additionally, Appendix A is a synopsis of current laws and regulations relating to the acquisition of EUCE.

IMPROVING THE MILITARY HOUSEHOLD GOODS MOVEMENT PROGRAM
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Three areas of the military household goods movement program are examined in this thesis: the household goods (HHG) inventory accountability process, freight forwarders contributions to the moving industry, and the price and quality differences between blanket wrapped household goods shipments loaded and moved in crates (code 2). The research questions examined in this thesis are: 1)what improvements can increase the efficiency of a military household goods inventory? 2)how do freight forwarders contribute to the efficiency and effectiveness of the moving industry? 3)should transportation officials consider using code 2 rather than code 1 for domestic moves? Recommendations include: improving the handwritten household goods inventory by the incorporation of a system similar to ALLFAX and the Transportation Operational Personal Property Standard System (TOPS), establishing more legislative controls to prevent freight forwarders from attempting to monopolize the household goods moving industry, and developing a lockable pallet size container or the utilization of a standard 20- or 40- foot lightweight standard container for use in code 2 vice code 1 shipments.

EVALUATION OF THE SHIPYARD MANAGEMENT INFORMATION SYSTEM (MATERIAL MANAGEMENT FUNCTIONS) AT THE LONG BEACH NAVAL SHIPYARD

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Despite efforts to improve material management through the reductions of inventories and the modifications of inventory management policies, Naval shipyards continue to experience the same problem, the shipyard management information systems material management function. An evaluation of this function against a theoretical "ideal" is made and recommendations for improvement provided. Results indicate that the information system has surpassed its useful lifetime and should be upgraded.

Nevertheless, and information system alone is not going to solve the material management problems. Rather, top management must develop a strategic business plan based on modern production management principles such as just-in-time and material requirements planning that encompasses the entire repair process from planning to production. Once developed, this plan could then be used to develop an information system based upon the required controls set forth in the plan.

A MULTIVARIATE ANALYSIS OF REENLISTMENT INTENTIONS AS A PREDICTOR OF REENLISTMENT BEHAVIOR

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Master of Science in Management - December 1988
Advisor: L.M. Solnick - Department of Administrative Science

The purpose of this thesis is to determine whether reenlistment intentions can help to predict actual reenlistment behavior. The sample consists of 6,328 Navy male enlisted members who are within one year of the reenlistment decision. The thesis constructs multivariate models consisting of numerous predictor variables. The variables are divided into three categories: demographic, reenlistment intentions, and job satisfaction variables. Results show that the most powerful predictor of reenlistment behavior is the reenlistment intentions variable. The results also show that reenlistment behavior is influenced by race,

age, pay grade, marital status, enlistment period, and level of satisfaction with the military in general. The study also estimates a model to show the relationship between the demographic and job satisfaction variables and reenlistment intentions. The model demonstrates that some demographic and job satisfaction variables indirectly influence reenlistment behavior through their impact on reenlistment intentions. Understanding the importance of intentions to reenlist during the one-year period prior to reenlistment can assist career counselors in their efforts to increase reenlistment rates.

HOW FEMALE OFFICERS' PERFORMANCE IN NON-TRADITIONAL U.S. NAVY SHIPBOARD JOBS COMPARES TO MALE OFFICERS' PERFORMANCE: A PROPOSAL FOR ANALYSIS

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Advisor: N. Roberts - Department of Administrative Sciences

Analyzing the performance in non traditional U.S. Navy shipboard jobs and comparing it to male performance was proposed. Almost no research has been done on this important question, and since the number of military women aboard ships is increasing, this data will become increasingly important. The objective of this thesis is to propose a way in which to analyze the performance of female officers in non

traditional shipboard jobs and to compare that performance jobs for males. The 2nd objective is to devise a study of greater methodological significance than has previously been attempted. A multi-method approach to measure performance is proposed. This research provides a methodology to test the hypothesis that there is no difference between the performance of female officers and male officers.

PREAWARD EVALUATION AND RESPONSIBILITY DETERMINATION OF FOREIGN CONTRACTORS
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International procurement is an important and complex aspect of defense acquisition. In fiscal year 1987, more than $3.8 billion in DOD contracts and subcontracts were awarded to foreign contractors. Adequate preaward evaluation of foreign contractors is essential to ensure price reasonableness and successful completion of the contract. This thesis identifies and examines the special considerations and unique problems in evaluating and determining responsibility of foreign contractors. Research data were obtained through interviews with corporate procurement managers and DOD contracting officers and program managers. The thesis provides useful guidance for contracting officers and program managers engaged in international acquisition and faced with evaluating foreign contractors.

A MULTIVARIATE ANALYSIS OF REENLISTMENT INTENTIONS OF NAVAL RESERVISTS
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Master of Science in Management - September 1989
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The purpose of this thesis is to identify factors that influence a selected Naval reservist's intention to reenlist in the reserves. The sample consists of 4060 Naval reserve male enlisted members drawn from the 1986 Reserve Components Survey. The thesis constructs a multivariate reenlistment model consisting of traditional predictor variables. Additional predictor variables were then added to determine if an improved model could be developed. Bonus payment, unit morale, acquaintances, and friendships, mobilization income and opportunity to serve one's country were the non-traditional variables found to positively influence an individual's decision to remain in the reserves. These variables added significantly to the predictive accuracy of the reenlistment model and should aid Navy managers in developing for increasing retention.

PREDICTING NIF CARRYOVER AT PUBLIC WORKS CENTER
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The scope of this research was the development of a statistical model for forecasting fund carryover for a Navy Public Works Center. The model was developed using monthly historical data from FY85 to FY88 for the following variables: 1) funds received; 2) billings; 3) backlog; 4) work in place; 5) carryover. A portion of the data required transformation to give it uniformity. Simple, multiple and stepwise regression methods were applied. Also, an examination was performed on whether there might be a lagged relationship between the dependent and independent variables.

IMPOUNDMENT TRENDS: FISCAL YEAR 1977 THROUGH 1988

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Master of Science in Management - December 1988
Advisor: J.L. McCaffery - Department of Administration Sciences

This thesis examines recessions and deferrals of budget authority made by Presidents Carter and Regan from 1977 through 1988. Trends in the use of recessions and deferrals are analyzed to determine the purpose of and the extent to which the President uses impoundment to control the pace of spending. The data collected for this period indicated that impoundment was used to influence policy more often than was intended by Congress. The President used impoundment to influence federal spending for more specific reasons. These include the use of impoundment to alter his predecessor's budget to establish different spending priorities and to maintain spending priorities when faced with reduced partisan political support in congress. The President appears to have inflated the budget submission for fiscal year 1985, and then impounded that budget at increased levels upon re-election. Impoundment that recommendations of national defense programs do not appear regional in their distribution.

AN ANALYSIS OF FOREIGN MILITARY SALES PROCEDURES (TURKISH PROCUREMENT EXAMPLE)

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Advisor: E.N. Hart - Department of Administrative Sciences

This thesis includes an analysis of United States Foreign Military Sales (FMS) Policy, U.S. Agencies concerned with FMS, and the documents that are used in the process. In the meantime, a specific Turkish FMS acquisition which is the conversion of the M48A1 tank to an M48A5 upgrade is explained in this thesis. It concludes with the problems facing field activities managing a Foreign Military Sales Program. The objective of this thesis is to improve the effectiveness of the Turkish Armed Forces in procuring weapon systems.

AN ANALYSIS OF THE CORRELATION BETWEEN BUDGET ASSERTIVENESS AND BUDGET SUCCESS

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Master of Science in Management - December 1988
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This thesis studies the relation between budget assertiveness and budget success in various Department of Defense budget accounts. It covers the budget formulation and Congressional enactment phase. It presents a model to discuss determinants of budget success and then focuses on one major component of success, assertiveness, defined as the percentage increment requested. The budget accounts which seem to be most rewarded by budget assertiveness for Fiscal Years 1977-1988 are Procurement, Marine Corps; the four services, Military Personnel accounts; Other Procurement, Air Force, and Other Procurement Army. The budget accounts which seem least responsive to budget assertiveness are Aircraft Procurement, Navy; Weapons Procurement, Navy; and Research, Development, Test, and Evaluation, Army.

ESSENTIALLY WEIGHTING MODELS FOR WHOLESALE LEVEL INVENTORY MANAGEMENT

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Item essentiality is currently determined in the U.S. Navy using an integer valued Item Mission Essentiality Code (IMEC). Unfortunately, this original coding scheme does not provide a means of determining how much more important an item with, say, an IMEC value of 4 is over an item with an IMEC value of 1. In addition, the Navy's wholesale level inventory models have no way of using these code values in determining spare and repair part inventory levels. An essentiality parameter E does exist in these models, but the Navy has not developed a way to convert IMEC values into E values. This thesis proposes four models for providing this conversion. These models incorporate ideas obtained from interviews with inventory management personnel at the Navy's Inventory Control Points. Implementing one of these models in conjunction with other recommendations presented in this thesis would result in stocking policies which better relate to the operational effectiveness for items stocked by the Navy's wholesale supply system.

THE EXTENSION OF TECHNOLOGY AND THE CONTROL OF PRODUCTION COSTS IN ADVANCED SATELLITE SYSTEMS

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Master of Science in Management - June 1989
Advisor: O.D. Moses - Department of Administrative Sciences

Advances in technology can affect production costs which in turn can be affected by a contractor's financial condition. The purpose of this thesis is to test the relationships between advances in technology, production costs and financial conditions of contractors. The analysis is conducted using data from a sample of satellite systems. This thesis describes the relationships between technology and productions cost with the goal of developing advances. The findings indicate that production cost is significantly associated with measures of technology and with measures of development cost. The relationships identified lay the foundations for projecting production cost. This thesis also examines relationships between control over production cost by contractors and their financial condition. The analysis suggests that aspects of financial condition may be indicators of a contractors ability to control production cost, but data limitations prohibit strong conclusions.

AN ANALYSIS OF FACTORS AFFECTING THE CAREER PLANS OF MILITARY NURSES

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Master of Science in Management - December 1988
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Department of Administrative Sciences

This thesis analyzes factors influencing a military nurse's decision to stay or leave the service. Data used were from the 1985 Department of Defense Officer and Enlisted Personnel Survey conducted for the Office of the Secretary of Defense by the Defense Manpower Data Center (DMDC). The likelihood of leaving is examined using a logistic regression (Logit) model with a dichotomous choice of decisions (leave / stay). The relative importance of various factors to the career decision is assessed. Factors identified in this study as significant in explaining the career decisions of non-obligated, military nurses include grade, satisfaction with freedom, satisfaction with promotion, gender and race. The results highlight potential policy variables which can be impacted by manpower policy planners to manage nurse retention.

A STUDY OF THE IMPACT USING IDTC/REQUIREMENTS CONTRACTS TO REDUCE THE PROCUREMENT ADMINISTRATIVE LEAD TIME (PALT) AT THE NAVY AVIATION SUPPLY OFFICE PHILADELPHIA

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This research was undertaken to study the impact of using requirements contracts to reduce Procurement Administrative Lead Time (PALT) at the Navy Aviation Supply Office. The methods used by ASO and other Department of Defense (DOD) Inventory Control Points (ICPs) to select requirements contracts candidates were analyzed for the essential selection elements that could be used for modeling the candidate selection process. An Automated Decision Support System (DSS) was developed to incorporate the essential elements into three models: 1)a Full Model for identifying candidates, 2)a Family Grouping Model for grouping Model for grouping of like items on the same contract, and 3) a PALT Reduction Model for assessing the impact of using requirements contracts. A test run of the DSS on 12,993 ASO inventory items revealed that the PALT for these items could be reduced by as much as 19% by expanding the use of requirements contracts.

IMPLEMENTING MANUFACTURING RESOURCES PLANNING FOR MARINE CORPS LOGISTICS BASE, ALBANY, GEORGIA

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In today's age of scarce DOD resources, the Depot Maintenance Activities (DMA) in all services are searching for ways to cut costs. One way for a DMA to accomplish this is to procure a more efficient automated production control system (APCS). Inventories, turn-around time, and labor costs all have the potential to be reduced with proper management supported by an appropriate and effective system. This thesis deals with the procurement and implementation of an APCS at the Marine Corps Logistics Base in Albany, GA. The current system in use at Albany is related, a system in the process of being implemented at the Naval Ordnance Station in Louisville, KY, is discussed in terms of system attributes and implementation concerns, and a system alternative in the Army DMA's Maintenance Shop Floor System is offered. Conclusions and recommendations include an EOQ vs. MRP inventory ordering discussion, repair part replacement factor forecasting and fill probability calculations, and general implementation recommendations.

THE SHIP CHARACTERISTICS AND IMPROVEMENT BOARD: A CRITICAL REVIEW

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One of the fundamental objectives of the ship design process in the U.S. Navy is the determination of the characteristics of a new ship. These characteristics are based on operational requirements, technical feasibility and cost constraints. This thesis is a critical review of the OPNAV organization responsible for this process: the Ship Characteristics and Improvement Board (SCIB). This thesis reviews the evolution of the ship design process, defines the mission and functions of the SCIB, and outlines SCIB procedures and policies. This thesis also focuses on the cost estimating methodologies NAVSEA and the Naval Center for Cost Analysis (NCA) use to derive and validate ship program costs. The results of this thesis indicate the need to improve the SCIB process through changes in the SCIB working Groups. The Navy also needs to develop an automated data base for ship costs to improve the quality of cost estimating.

MANAGING TO PAYROLL: AN EVALUATION
OF LOCAL ACTIVITY DATA MANAGEMENT
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Master of Science in Management - June 1989
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This thesis evaluates particular problems in the effective implementation of Managing to Payroll at non industrial Naval Shore activities. These problems stem from the Navy's efforts to improve control over civilian labor costs. These efforts failed to address the specific mechanisms necessary for successful payroll budget execution at the activity level. Concurrent transformation in Department of the Navy accounting systems under Integrated Disbursing and Accounting (IDA) concept may be adding to the problems associated with aspects of Managing to Payroll. The labor cost data management procedures at the Naval Postgraduate School (NPS) Monterey were examined in detail. These procedures, developed locally, are designed to support compliance with the requirements of Managing to Payroll. An analysis of these procedures and the associated reporting functions form the core of this study. Recommendations to improve the existing data management system and reporting functions are included.

USE OF LIFE CYCLE COSTING IN THE DEVELOPMENT OF STANDARDS
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The study set out to determine how, and to what extent, life cycle costing is used in the development of voluntary consensus standards. It explains how several organizations in the commercial sector develop voluntary standards. Among these organizations were ASHRAE, who is currently developing a standard based on life cycle costing. Standard 90.2 "Energy Efficient Design of New Low-Rise Residential Buildings" prescribes the insulation values for the envelope of a building. The economic methodology was based on marginal analysis by considering an upgraded construction component and then determining the incremental energy cost savings to the incremental modification costs over a specified life cycle period. Questions arose concerning the economic assumptions used in developing the standard. It is recommended that an impact study be performed to evaluate the coat estimating techniques and the basic economic assumptions.

A PROPOSAL FOR IMPROVEMENT OF SUPPLY SUPPORT
FOR SHIP OVERHAULS IN THE HELLENIC NAVY
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B.A., Graduate School of Public Studies, 1975
B.A., Research Center "Dimocritos," 1979
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The Hellenic Navy currently conducts ship overhauls without adequate planning for supply support. As a consequence, many of the overhaul tasks cannot be completed in the time allowed for the overhaul. This thesis proposed a new supply support system consisting of an inventory model designed to provide the necessary spare and repair parts needed during a ship's overhaul and a demand forecasting method to support the model. A longer planning horizon is also proposed to insure on-time delivery of the appropriate material. A modification in the current supply support responsibility is then proposed as a last step towards implementing the new supply support system.

A CASE STUDY OF THE MK 16 MOD O
UNDERWATER BREATHING APPARATUS PROGRAM

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Master of Science in Management - June 1989
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The MK 16 MOD O Underwater Breathing Apparatus (UBA) provides life support to EOD divers operating in close proximity to sensitive underwater ordnance. This thesis evaluates the acquisition and logistic strategy used in fielding this acquisition category III system. In addition current material the logistic support problems were examined and analyzed. The final chapter provides conclusions and recommendations based on the "lessons learned" in fielding this system.

LESSONS LEARNED FROM THE IMPLEMENTATION OF TOTAL QUALITY MANAGEMENT AT THE NAVAL AVIATION DEPOT, NORTH ISLAND, CA.

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Master of Science in Management - December 1988
Advisor: E.N. Hart - Department of Administrative Sciences

Total Quality Management (TQM) has been presented as a way to improve productivity at Department of Defense installations. There are many obstacles to the successful implementation of TQM in a military organization. This thesis defines TQM. It documents the implementation of TQM at the Naval Aviation Depot, North Island, San Diego, California. It presents the lessons learned during the implementation, recommendations for further implementation, and demonstrates that any organization can benefit from TQM philosophies.

LOGISTIC SUPPORT FOR NON-DEVELOPMENT ITEMS

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The objectives of this research are: 1) to examine how the decision is made to use a Non Developmental Item (NDI) to meet an operational requirement; and 2) to formulate an evaluation model that could be used by the decision maker to determine which support method would be most suitable for the NDI in question. In formulating the model presented in this thesis (the Support System Decision Matrix), actual cases of NDI acquisitions were studied and the lessons learned from these efforts were consolidated into a model. The heuristic considers system use factors and system specific factors and ranks the four basic ways to support a system: 1)discard system upon failure (no support), 2) total contractor support, 3) organic support and 4) a combination of organic and contractor support. Conclusions and recommendations focus on how the military services can field effective systems by using the NDI process. The NDI process often makes sense from both an economic and a time perspective, but strict attention must be given to the logistic support requirement for these systems when fielded.

INTENT, IMPACT AND PUBLIC POLICY CONSEQUENCES OF INCREASED CONGRESSIONAL CONTROL OF DEPARTMENT OF THE NAVY BUDGET EXECUTION
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Master of Science in Management - December 1988
Advisor: L.R. Jones - Department of Administrative Sciences

This thesis 1) reviews constitutional and legislative foundations for congressional control and oversight over DoD, 2) discusses methods of control and oversight, 3) documents a trend toward increasing control and oversight, 4) evaluates potential explanations for this trend 5) investigates the intent of line item specification and restrictive language in authorization bills, appropriations bills, and committee reports, and 6) examines their impact on DoN budget execution. It concentrates on DoN procurement accounts for 1980-88 and Aircraft Procurement, Navy (APN) for 1988. It concludes that 1) the intent of increased oversight and control is to ensure that the will of Congress is carried out by the Execution, 2) congressional budgetary decisions may impede DoN budget execution efficiency and effectiveness, and 3) the full impact of these controls did not occur in APN in 1988 because negative and unintended consequences were pointed out to Congress by DoN and the controls were partially rescinded.

BUDGET ANALYST TRAINING IN NAVY TYPE COMMANDS
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Master of Science in Management - June 1989
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The research for this thesis has been conducted to determine the adequacy of training support available to prepare budget analysts to do their jobs relative to position requirements. A survey was distributed to the comptrollership of COMNAVAIRPAC and COMNAVSURPAC and to their subordinate field level activities. Responses indicate that the primary source of training for budget analysts is on the job training. In addition to the findings are that there is a lack of entry level training for budget analysts and a high job turnover rate. Areas mentioned by analysts and supervisors as requiring additional training support are: computer utilization and automated data processing skills, writing budget justifications, IDAFMA, and the Navy Financial management system.

BARRIERS FACED BY MINORITY BUSINESSES IN OBTAINING GOVERNMENT CONTRACTS
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Master of Science in Management - December 1988
Advisor: D.V. Lamm - Department of Administrative Sciences

This thesis examines specific commodity areas lacking minority business participation; namely, Federal Supply Classes (FSC) 3100 (Bearings), 4700 (Pipe Tubing, Hose and Fittings), and 4800 (Valves). This research examines why these areas lack minority business participation. The focus is on factors keeping minority businesses out of these commodities and what can be done to encourage firms to obtain Government contracts in these areas.

MASTER OF SCIENCE
IN
MECHANICAL
ENGINEERING

NUCLEATE POOL BOILING PERFORMANCE OF SMOOTH AND FINNED TUBE BUNDLES IN R-113 AND R-114/OIL MIXTURES

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Master of Science in Mechanical Engineering - June 1989
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Department of Mechanical Engineering

Heat-transfer measurements were made for boiling of refrigerant oil mixtures form smooth and finned tube bundles. The bundles contained 15 heated tubes arranged in an equilateral triangular pitch of 19.1 mm. The outside diameter of the smooth tubes (15.8 mm) was equal to the diameter to the tip of the fins of the finned tubes. The smooth tube bundle was tested in pure R-113 with varying surface "histories" as well as with pure R-114 and R-114/oil mixtures. The finned tube bundle was tested in pure R-114 3,6, and 10% by mass. The majority of data sets were taken with decreasing heat flux where hysteresis is normally not seen as found in the present experiments when using the simulation heaters. The addition of oil to the smooth tube bundle showed heat-transfer performance to increase over that measured with pure R-114 up to a 6% concentration. The maximum enhancement in heat-transfer performance of the smooth tube bundle was around 44% with R-114 and 2% oil. Performance was only slightly degraded from the case of pure R-114 at the maximum oil concentration of 10%. Heat-transfer performance was more than doubled for the finned tubes when compared to that for the smooth tubes. Addition of oil to a concentration of 3% by mass, yielded a maximum increase in finned-tube performance of 22% over that measured with pure R-114.

FLOW VISUALIZATION OF TIME-VARYING STRUCTURAL CHARACTERISTICS OF DEAN VORTICES IN A CURVED CHANNEL

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The time varying development and structure of Dean vortices were studied using flow visualization. Observations were made over a range of Dean numbers from 40 to 200 using a transparent channel with mild curvature, 40:1 aspect ratio, and an inner to outer radius ratio of 0.979. Seven flow visualization techniques were tried, but only one wood burning smoke generator, produced usable results. Different vortex characteristics were observed and documented in sequences of photographs spaced one quarter of a second apart at locations ranging from 85 to 135 degrees from the start of curvature. Evidence is presented that supports the twisting/rocking nature of the flow.

OPTIMIZING SUPERPLASTIC RESPONSE IN NAVALITE; A LITHIUM CONTAINING ALUMINUM-MAGNESIUM ALLOY

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Superplastic ductilities up to 428% have been attained during research into thermomechanical processing of Al-2.70Mg-2.04Li-0.50Cu-013Zr (compositions in wt.pct.; alloy composition corresponding to NAVALITE). Variation in dislocation density induced by means of warm rolling at a series of temperatures below the discontinuous recrystallization temperature were expected to significantly affect the superplastic response by further grain size refinement. Experimental results indicate no beneficial enhancement in ductilities associated with rolling below 250 C. Consistent elongations in the 400% range during this initial evaluation of the NAVALITE alloy indicated further investigation of super-plasticresponse is warranted.

THERMOMECHANICAL PROCESSING OF ALUMINUM
ALLOY 2090 FOR SUPERPLASTICITY

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The effect of processing variables on the microstructural development and superplasticity of aluminum ally 20990, a high strength Al-Cu-Li-Zr alloy of reduced density in comparison to other Al-based materials, was investigated. Following previous research, warm rolling was conducted to strains up to 3.36 and it was found that increasing the strain to values greater than 2.6 offered no improvement in subsequent superplastic response. Increased rolling speeds likewise did not enhance ductility above a maximum value of approximately 240 percent. Microstructural examination revealed a refined, homogeneous microstructure consisting of T2 particles distributed in an alloy matrix. These particles reside at triple junctions in a recovered microstructure.

EFFECT OF VORTEX CIRCULATION ON INJECTANT FROM A SINGLE FILM COOLING HOLE AND A ROW OF FILM-COOLING HOLES IN A TURBULENT BOUNDARY LAYER, PART I, INJECTION BENEATH THE VORTEX DOWNWASH

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The effects of longitudinal vortices on film-cooling injectant from a single injection hole and form a row of injection holes in a turbulent boundary layer are investigated. Attention is focused on the effects of vortex circulation when the injection hole is located beneath the vortex downwash. Heat transfer measurements mean velocity and mean temperature surveys, and surface flow visualization results are discussed. The embedded vortex considerable disturbs the injectant when $\Gamma /(Uc.d)$ is greater than 1.0, where Γ is the vortex circulation, Uc is the injectant mean velocity and d is the injection hole diameter.

A BASELINE CONTROL SYSTEM FOR MARINE GAS TURBINE COMPRESSOR SURGE

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United States Navy gas turbine ships are in need of casualty control system updating to reduce demanding conditions on engineering watch standers, to increase equipment longevity, and reduce operating costs. This thesis presents a baseline computer-based expert system controller concept developed for the critical casualty control problem of gas turbine compressor surge. The controller design rests on the building-block components of realtime gas turbine simulation and compressor surge characterization, which are discussed. The logic and rules for the expert system design are presented, as is a dynamic investigation of the expert system diagnostic performance.

A MICROSTRUCTURAL INVESTIGATION OF THE SHEAR DISTORTIONS AND ENERGETICS OF MOTIONS OBSERVED IN AN AGED HIGH DAMPING 53CU-45MN-2A1 ALLOY

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The shear distortions developed upon aging of a 53Cu-45Mn-2A1 alloy were studied using a transmission electron microscope image extinctions and diffraction spot streak analysis. It was determined that a lattice distortion of {110} planes, in <111> directions developed in the alloy as aging progressed. This matured <111> shear induces a distinct V-shaped contrast which displays dynamic motion under the electron-beam irradiation of TEM examination.

Video imaging techniques were applied to this dynamic activity termed "flickering," to investigate the energetics of the underlying crystalline lattice motion. The realtime behavior at the flicker sites suggests that the underlying mechanism which produces the dynamic contrast change is a gradual crystallographic transition, typical of a second-order phase transition. The flicker contrast motion displayed many of the characteristics of "chaotic vibrations."

TURBULENCE STRUCTURE RESULTING FROM INTERACTION BETWEEN AN EMBEDDED VORTEX AND WALL JET

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Interactions of wall jets and vortices embedded in turbulent boundary layers commonly occur near gas turbine blades and end-wall surfaces. In this research, a crossed hot-wire probe is used to measure the turbulence structure resulting from this type of interaction. The vortex is generated using a half-delta-wind vortex generator mounted at 12 degrees with respect to a 10 m/s mean velocity flow over a flat plate. A single injection hole, .95 cm in diameter, inclined 30 degrees to the horizontal, is located under the vortex downwash, 58 cm downstream vortex generator. Baseline measurements were made at one streamwise location downstream of the injection hole for the cases: 1) boundary layer only, 2) boundary layer with vortex, and 3) boundary layer with wall jet.

Measurement of the interaction between the boundary layer, vortex and 2.5 blowing ration wall jet was also made at this location. The 1.5 blowing ration wall jet interaction was measured at three additional streamwise locations. Reynolds stress tensor components, vorticity distributions and mean velocities show that the vortex rotation significantly alters the turbulence structure of the 1.5 blowing ratio wall jet at all four streamwise locations. Here the injectant is swept away from the injection hole by the vortex rotation. The most significant alterations to the turbulence structure occur in the vortex upwash region and beneath the vortex core. The 2.5 blowing ratio jet is much more resistant to disturbance by the vortex.

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THE APPLICATION OF BRIAN'S METHOD TO THE SOLUTION OF TRANSIENT HEAT CONDUCTION PROBLEMS IN CYLINDRICAL GEOMETRIES

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A FORTRAN 77 computer code employing an adaptation of the finite differencing algorithm proposed by Brian was developed for the solution of transient heat conduction problems in cylindrical geometries. Validation of code was accomplished by comparison with an analytic solution derived for a model with symmetric, linear boundary conditions. Accuracy of results for asymmetric and nonlinear boundary conditions was determined by comparison with a similarly validated code employing the explicit method. Code effectiveness was then demonstrated by conducting transient temperature analysis for a simulated earth-orbiting satellite. Brian's method demonstrated unconditional stability with associated significant reductions in execution time compared to the explicit method. The effects of discretization error on the accuracy of results require further investigation.

THE EFFECT OF AGING TREATMENT ON THE MICROSTRUCTURE AND PROPERTIES OF COPPER-PRECIPITATION STRENGTHENED HSLA STEEL

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The high strength low alloy (HSLA) steels which are being developed as replacements for the HY family of steels are low carbon steels which derive their strength in part due to the precipitation of fine coherent copper particles formed during a quench and aging heat treatment. HSLA-100 is being developed to meet the strength and toughness requirements of HY-100, but can easily welded without preheat, thereby reducing fabrication costs. This investigation uses light and electron microscopy for the microstructural characterization while tensile, Charpy, and hardness tests are relied upon for the mechanical properties. The microstructure and mechanical characteristics of HSLA-100 after aging at several different temperatures was correlated. A high ductility and the minimum 100 ksi yield strength was found after aging at 675 C, although this temperature was found to be close to the low eutectoid temperature displayed by HSLA-100. Splitting was observed in the tensile fracture surfaces, but the mechanical properties were not adversely affected.

EFFECT OF VAPOR VELOCITY DURING CONDENSATION ON HORIZONTAL FINNED TUBES

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Heat-transfer measurements were made for condensation of R-113 and steam on a smooth tube and on three finned tubes with rectangular shape finds. These tubes had a fin height and width of 1.0 mm and spacing of 0.25, 1.5, and 4.0 mm (tubes A, B, and C, respectively). Data were taken by increasing the vapor velocity from 0.4 to 1.9 m/s for R-113 and 4.8 to 31.3 m/s for stream. For both fluids, the improvement of the condensing heat-transfer coefficient with vapor velocity was smaller for the finned tubes than for the smooth tube. For R-113, the smooth tube experienced a 32 percent improvement with vapor velocity, where the finned tubes (tubes A, B, and C respectively) experienced improvements of only 0, 5, and 10 percent. For steam, the smooth tube experienced a 62 percent improvement, whereas the finned tubes A, B, and C respectively) experienced improvements of only 31, 11, and 9 percent. These test results show that, although finned tubes can provide significant heat transfer enhancement over smooth tubes at low vapor velocities, the degrees of enhancement becomes smaller as vapor velocity increases.

DEVELOPMENT, QUALIFICATION AND MEASUREMENTS IN TWO CURVED CHANNELS WITH 40 TO 1 ASPECT RATIO

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Studies were conducted in two channels with identical interval dimensions. Each channel has mild curvature, 40 to 1 ratio, and 1.27 cm by 50.08 cm rectangular cross section. One channel is used for visualization, and one is used for heat transfer measurements. As part of the study, assembly of the heat transfer channel was completed along with qualification tests of internal flow behavior. In the transparent channel, videos and still photographs were taken of visualized flow for Dean numbers from 60 to 200 and angular positions form 85 degrees to 175 degrees from the start of curvature. These data provide new information on the unsteady behavior of Dean vortex pairs, especially how vortex paris merge and divide.

Assembly of the heat transfer channel included installation of insulation to minimize conductive heat losses, completion of wiring of thermocouples used for surface temperature measures, wiring of thermocouples used for surface temperature measurements wiring of heater poser supplies and controlling systems, and assembly of piping form the blower to the channel including installation of regulation valves and flow metering orifices. Velocity and pressure surveys were conducted downstream of the instrumented section. For Dean numbers form 50 to 158, these distributions were either spanwise uniform or spanwise periodic, as expected, providing qualification of internal behavior in the channel.

MODELING AND CONTROL OF A NOVEL ROBOTIC ACTUATOR

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With the increased use of robots in industry and the military, new robot-specific actuators will be developed to better meet functional requirements. One concept to be considered is a stiff pneumatic-hydraulic actuator for mobile anthropomorphic robot application. This thesis documents analysis of the feasibility of such an actuator. Computer modeling and simulation are accomplished. A hardware test bed

with microcomputer control and parameter sensing interface is designed and constructed for the purpose of model validations and demonstrations. Automatic control software is designed and implemented on the test bed, and performance evaluations are made. From the observations made during the analysis process, design recommendations are formulated and proposed.

CONTROL SYSTEM DESIGN OF THE THIRD FLEXIBLE JOINT OF PUMA 560 ROBOT

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With the increased demands for higher productivity in industry and the military, control of Robot Manipulators with flexible joints is needed. The difficulties associated with the control of flexible joint robots include the following: 1) Nonlinearity of the arm motion, 2) Coupled large motion (motion of the motor), and small motion (mechanical vibration), and 3) measurements of feedback signals. This thesis presents a controller designed to handle the

difficulties related to flexible joint robots. The third joint of the PUMA 560 Robot was selected as an example. A control algorithm for flexible body control was devised and an observer was designed with the use of MATRIXx to control tip motion of the single-link single-joint system. Computer simulation results are discussed, and a comparison between rigid-body controllers and the flexible-body control is conducted.

PARAMETRIC STUDY OF THE DYNAMIC STABILITY OF TOWED VESSELS

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Several accidents in towing operations of barges or disabled ships in restricted and open waters have made necessary the investigation of the course keeping stability of towed vessels. In this work, a non-linear mathematical model is used to simulate the slow surge, sway, and yaw motions of a vessel towed by a heavy catenary towline. The effect of geometric parameters of the system on the stability of equilibrium configurations is analyzed. It is shown that for certain choices of towing system parameters, dynamic loss of stability may occur which results in qualitatively different asymptotic response. The results of this study identify regions in the parameter space that lead to either safe operations or hazardous system response.

CALNPS COMPUTER ANALYSIS LANGUAGE NAVAL POSTGRADUATE SCHOOL VERSION

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The Computer Analysis Language (CAL) Program was originally written by Professor Edward L. Wilson of the University of California at Berkeley as a teaching tool for structural analysis. The program was modified for use on the Naval Postgraduate School (NPS) main-frame (IBM 360/67) in 1979 by Lawrence B. Elliott, Lieutenant Commander, U.S.N., integrated the Finite Element Analysis Program (FEAP) with CALNPS. This provided a means for the solution of linear and nonlinear, two and three dimensional, and steady state and transient heat conduction problems. Roberts also generated an interactive "HELP" facility and the code for terminal graphics displays of heat transfer and structural analysis meshes. Since then, changes to the NPS computer system and transition of CALNPS to the VAX computer system have rendered CALNPS unusable in many ways. The "HELP" facility is obsolete. The purpose of this thesis was to bring CALNPS back up to date, rewrite the "HELP" facility, and make the program "user friendly." Also several modifications were added to CALNPS. The graphics capabilities were expanded to include hardcopy options using the Plot 10 and Display graphics libraries. Two display size options are now available and the user now has the capability to plot curves from data files form within the CALNPS domain. As CALNPS is a very large program, several of the functions available had not been tested completely and as a result did not work at all or did not work in the manner described in the user's manual. This thesis work included the testing of every command and verifying that they work in accordance with the user's manual. Several problems were discovered and corrected by either changing the FORTRAN code or the instructions or both. The work was focused around of the VAX computer system.

FLOW VISUALIZATION STUDIES IN (1) A CURVED RECTANGULAR CHANNEL WITH THE 40 TO 1 ASPECT RATIO AND (2) A STRAIGHT CHANNEL WITH IMPOSED BULK FLOW UNSTEADINESS

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Flow visualization results are presented which were obtained in a curved channel with mild curvature and 40 to 1 aspect ratio. Inside channel dimensions are 1.27 cm x 50.80 cm. For Dean numbers from 60 to 200 and angular positions from 85* to 175* measured from the start of curvature, video movies and photographic sequences of patterns in spanwise/radial planes show unsteady Dean vortex pari behavior. In particular, information is provided on mechanisms by which vortex paris appear and disappear. Videos and still photographs of visualized flow in a straight channel with 40 to 1 aspect ration and imposed bulk flow unsteadiness show different stages of transition including: 1) three-dimensional Tollmien-Schlichting waves, 2) Lambda waves, 3) Lambda vortices 4) vortex type motion, 5) turbulent spots and 6) fully turbulent flow. Instantaneous velocity traces from hot-wire probes are presented for Reynolds numbers from 1400 to 8400 and Strouhal numbers from 0.004 to 0.047. These data, without unsteadiness, show that the transition occurs at a Reynolds number of approximately 3000. With imposed sinusoidal unsteadiness at Strouhal number 0.028 and 7% peak to peak amplitude (relative to the mean velocity), transition occurs at a Reynolds number of approximately 2300.

CONDENSATION OF REFRIGERANTS ON SMALL TUBE BUNDLES

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The construction of an apparatus for the condensation performance testing of a horizontal bundle of four tubes with various refrigerants was completed. The apparatus was instrumented, and data reduction software was developed to provide bundle and single tube condensation data. Two tube bundles were tested, smooth cooper tubes and low integral-fin copper-nickel tubes, with two refrigerants, R3-114 and R-114. An enhancement was demonstrated for the finned tubes over the smooth tubes. Internal contamination, possibly due to a breakdown of the refrigerant molecules when subjected to high temperatures in the boiling chamber, inhibited further meaningful data collection. Recommendations for improvement of the test apparatus are made.

MODEL BASED DESIGN AND VERIFICATION OF A RAPID DIVE
CONTROLLER FOR AN AUTONOMOUS UNDERWATER VEHICLE

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Autonomous Underwater Vehicles are being considered today by many organizations as low cost substitutes for manned vehicles. Requirements for autonomy emphasize the need for a robust system controller that can adequately maneuver the vehicle and ensure precise tracking of a planned path. This thesis presents the determination of hydrodynamic coefficients for vertical motion of a radio controlled underwater vehicle based on open loop testing. The equations of motion were manipulated using software Matrix-x to create a satisfactory closed loop control system for rapid maneuvering in the vertical plane. Because vehicle data provided by onboard sensors was limited, both state estimation and disturbance estimation / compensator techniques were used, leading to a model based compensator which enhanced control. Results show that a satisfactory closed loop control design can be achieved using these modern controller design techniques. The extension to the design of steering control is addressed.

COMPOSITE MATERIAL REPAIR AND RELIABILITY

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Composite structure repair methodology has been developed to specific applications (typically in small area and limited to secondary structure) and is being extended to large Area Composite Structure Repair (with target extension to primary structures). Therefore, the repair becomes more critical because we get redistribution of stresses that can also affect the zone outside of the repair area. For this reason, an analytic evaluation of the repair's reliability has to be performed to define a parameter which reflects on the effectiveness of the repair. In this work, we establish a principal guideline to evaluate the redundance and compare the reliability of the repair to the reliability of the parent structure (i.e., the structure in the undamaged state). The approach adopted is to utilize structural finite element analysis to compute the state of stress at all the spatial elements of structure of the damaged state and of the candidate repaired state. The reliability of these two spatially non-uniform stresses is computed by a probabilistic failure criterion. Thus, we can optimize the repair configuration by varying the strength and the stiffness of any element in the repair site by varying lamination angles, and selectively using hybrid materials.

AEROTHERMODYNAMIC ANALYSIS OF A COANDA
REFRACTION JET ENGINE TEST FACILITY

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A computer model of the Coanda Refraction Jet Engine Test Cell facility was developed using the PHOENICS computer code. The PHOENICS code was utilized to determine the steady state aerothermal characteristics of the test cell during the testing of an F404 gas turbine engine with afterburner in operation. Computer generated aerothermodynamic field variable of pressure, velocity and temperature parameters were compared to operational field test data. Observations regarding compared results as well as system behavior are presented. Additionally, recommendations of the applications of PHOENICS to future modeling projects are made.

STRESS RELIEF CRACKING IN COOPER-PRECIPITATION STRENGTHENED HSLA-100 STEEL

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The US Navy is currently developing a new family of high strength, low-alloy steels which derive a significant portion of their strength from copper precipitation. These highly weldable steels require little or no preheat, resulting in substantial cost savings. The first of these steels, HSLA-80, has been certified for ship construction, but recent studies have indicated some susceptibility to stress relief cracking in weldments. HSLA-100, a modification of HSLA-80, is now being considered for several higher-strength Naval structures. Stress-relief cracking has not been studied previously in this steel and is the subject of investigation of this work. The steel weldments were loaded below their yield strength to temperatures of 550-650 degrees C, and permitted to stress relieve for one hour. At all temperatures, the steel exhibited susceptibility to stress relief cracking in certain stress ranges. Optical and scanning electron microscopy exhibited intergranular cracking which always traversed the coarse-gained region of the heat-affected zone. Auger and transmission electron microscopy indicated high concentrations of alloying elements at the grain boundaries. Stress-relief cracking was associated with the diffusion of alloying elements to the prior austenite grain boundaries.

THE EFFECT OF WELDING PROCESS ON THE MICROSTRUCTURE OF HY-130 STEEL WELDMENTS

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HY-130 is high-strength, low-carbon steel used in the quenched and tempered condition. It is designed for high performance and marine application where good weldability is a requirement. Optimum welding parameters are currently under investigation. In this study, 1/2 inch (12.7 mm) HY-130 steel weldments produced by submerged arc welding (SAW) and gas metal arc welding (GMAW) processes are compared by means of a systematic microstructural characterization of the base metal, weld metal, and heat affected zone (HAZ). The microstructures are characterized by optical and electron microscopy and microhardness measurements are performed in the weld metal and across the HAZ to relate the microstructure with the micro-hardness profiles. The weld metal microstructure of both weldments showed a predominantly martensitic structure and contained more retained austenite and twinned martensite. The SAW weld metal had a less defined lath structure which was more bainitic. The microhardness values were higher in the GMAW weld metal. No significant differences in microstructure and hardness were observed in the HAZ of the two weldments.

REAL TIME MARINE GAS TURBINE SIMULATION FOR ADVANCED CONTROLLER DESIGN

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The Marine Gas Turbine control systems in present use in the U.S. Navy are of such significant technological age that new design techniques could lead to more optimum performance and increased plant efficiency. To this end, a new real time Marine Gas Turbine simulation method is needed for advanced controller design and implementation. A modeling method is shown which utilizes real time sequential linearizations to approximate the true norlinear response of the NPS Boeing 5026A test facility. A validation of this simulation approach is presented. The method has immediate application to advanced controller design, especially to the design of modern regulators (Linear Quadratic), model reference controllers, and real time diagnostics.

EFFECT OF HEATING RATE TO TEST TEMPERATURE ON SUPERPLASTIC RESPONSE IN AN Al-8%Mg-1%-0.2% Alloy

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The effect of heating rate to tension test temperature on superplastic response in an Al-8%Mg-1%Li-0.2%Zr alloy was studied. A thermomechanical process (TMP) was used that involved warm rolling with controlled reheating between rolling passes. During the TMP, microstructural evolution was controlled by a continuous reaction (CRX). Previous work has shown that grain sizes as fine as 1 micron can be obtained with superplastic ductilities in excess of 1000% at 300*C and a strain rate of 1.7x10-2 s-1.

In this work, superplastic response was studied using five heating rates, ranging from 7.1x10-3 C/s to 2.4x10+1 *C/s, following TMP. Heating rates greater than 10*C/s resulted in a discontinuous reaction (DRX) with a likely coarsening of grain size. Conversely, high ductilities and enhancement of superplasticity resulted form slower heating rates (<1*C/s) that facilitated recovery and CRX in a microstructure already highly refined by CRX during the TMP.

EXPERIMENTS ON LIQUID IMMERSION NATURAL CONVECTION COOLING OF LEADLESS CHIP CARRIERS MOUNTED ON CERAMIC SUBSTRATE

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An experimental investigation of natural convection heat transfer from a commercially available semiconductor device package is presented. The package was centrally mounted on a ceramic substrate. The package-substrate assembly formed one surface of a dielectric-filled cubical enclosure of aspect ratio one. The top surface of the enclosure was maintained at prescribed temperature. Surface temperature measurements were made at various locations on the substrate, the package lid, as well as the chip center. These measurements are reported for

three dielectric fluids and three enclosure top surface temperatures, both with the substrate oriented horizontally as well as vertically. Heat transfer results are also expressed in nondimensional form. The results indicate that the maximum input power without exceeding a chip junction temperature of 80*C is 2.58 watts with FC-75 as the cooling fluid and the upper boundary maintained at 15*C. This is significantly larger than the maximum of 1.221 watts allowable with the natural convection air cooling.

THE EFFECT OF HEAT INPUT AND COMPOSITION ON WELD METAL MICROSTRUCTURES IN THIN SECTION HY-130 GMAW WELDMENTS

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Thin section HY-130 is being considered by the U.S. Navy for use in decks and foundations in the SSN-21 design as a weight saving measure.. Optimum welding procedures for thin section HY-130 do not currently exist, but they are being developed by David Taylor Ship Research and Development Center (DTNSRDC). In this study, performed in conjunction with DTNSRDC, the effect of heat input and electrode composition on the weld metal microstructures and mechanical properties of four 12.7 mm thick HY-130 steel weldments produced by the GMAW process

are reported. Microstructures were fully characterized by light and electron microscopy. Mechanical property results provided by DTNSRDC were correlated with the microstructure. The lower heat input produced microstructural refinement and a more uniform hardness. The higher carbon content electrode lowered the Ms temperature and stabilized the austenite. A microduplex structure of lath martensite and thin film interlath retained austenite produced a good combination of strength and toughness.

FILMWISE CONDENSATION ON LOW INTEGRAL-FIN TUBES OF DIFFERENT DIAMETER

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Heat transfer measurements were made for filmwise condensation of R-113, steam and ethylene glycol on three sets of finned tubes which differed only in root diameter. The fin root diameters were 12.7 mm. 19.05 mm and 25.0 mm. A comparison of the enhancement within the range of diameter tested, the effect of root diameter was small. Results indicated that two or more trends may exist while increasing root diameter. With the exception of the small diameter tubes with steam, a change in root diameter did not effect the optimum fin spacing for each fluid tested. The optimum fin spacing for the small diameter tubes with steam was approximately 2.0 mm, while the medium- and large diameter tubes had an optimum fin spacing for R-113 and ethylene glycol was found to be 0.5 mm and 1.0 mm, respectively. A comparison between the outside heat transfer coefficients of the medium-diameter tubes for R-113 and steam with past NPS investigation showed an agreement within ± 10 percent respectively.

NATURAL CONVECTION FROM AN ARRAY OF RECTANGULAR PROTRUSIONS IN AN ENCLOSURE FILLED WITH DIELECTRIC FLUID: EFFECTS OF BOUNDARY CONDITIONS, FLUID PRANDTL NUMBER, AND SELECTIVE COMPONENT POWERING

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An experimental investigation has been conducted to further examine natural convection immersion cooling of a three array of heated protrusions in a rectangular chamber filled with dielectric fluid. Each rectangular protrusion geometrically modelled a 20 pin dual-inline-package. Input power to each component varied from 0.1 to 3.0 W. The purpose of this study was to examine the effects of the following parameters for the range of power level selected: 1) Top and bottom boundary temperatures. 2) Selective power of components. 3) Changes in the fluid Prandtl number. The data were obtained as component surface temperatures. These were subsequently presented in terms of appropriate nondimensional parameters. As part of the overall investigation, flow visualization results are also presented for selected conditions.

THE MICROSTRUCTURAL BASIS OF DAMPING IN HIGH DAMPING ALLOYS

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The microstructural mechanisms responsible for material damping are analyzed, with emphasis on those mechanisms responsible for the behavior in high damping alloys. A Cu-Al-Ni alloy is metallurgically characterized using transmission electron microscopy and differential scanning calorimetry. The structural characterization of the Cu-Mn alloy INCRAMUTE is refined using a high resolution transmission electron microscopy and high resolution energy-dispersive x-ray spectroscopy. A qualitative theory for the strain dependance of damping capacity is given.

PROCESSING AND ELEVATED TEMPERATURE
DUCTILITY OF ALUMINUM ALLOY 7475

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Master of Science in Mechanical Engineering - June 1989
Advisors: T.R. McNelley - Department of Mechanical Engineering

This research has initiated investigation of Al alloy 7475 (Al-Zn-Mg-Cu) in regard to the effects of thermomechanical process (TMP) variables on the superplasticity. These effects are evaluated by pct. elongation at temperatures ranging from 300-450*C and strain rates of 6.7x10-3 to 6.7x10 s-1 and microstructural analysis. In comparison to results in the literature, superplastic ductility for lower temperature, higher rate superplasticity may be enhanced.

PARAMETRIC STUDY OF THE AEROTHERMODYNAMICS
OF A JET ENGINE TEST FACILITY

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A three-dimensional numerical model of the Jet Engine Hush House located at Naval Air Station Jacksonville, Florida was developed using the PHOENICS computer code. The PHOENICS code was used to determine the steady state aerothermal characteristics in the Hush House produced by a Navy F-4 (Phantom II) J-79-GE-8 gas turbine engine with afterburner. The PHOENICS generated pressure, velocity, and temperature fields of the test cell facility based on the k-E turbulence model are compared with results generated by a model incorporating a temperature dependent kinematic turbulent viscosity. In addition, for the k-E turbulence model, the effect of augmenter tube length on system behavior was investigated. Lessons learned and recommendations in obtaining a converged solution are included to aid in further applications of the PHOENICS code.

FREE SURFACE SCARS STRIATIONS

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June 1989
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A numerical and experimental investigation of the interaction of a pair of vortices with a free surface has been undertaken. The analysis is based on the vortex-sheet representation of the free surface and the use of the appropriate boundary conditions. The experiments were performed in a large basin and the vortices were generated through the use of a special nozzle. The rise of the resulting Kelvin oval, the trajectories of the vortices, and the instantaneous shape of the free surface were recorded on a video tape and then carefully analyzed through the use of a Motion Analysis system. The results have shown that the rise of the vortices not only gives rise to two scars, with a pronounced hump in middle, but also, and more importantly, to a three-dimensional instability heretofore unknown. The measured and calculated vortex trajectories and the free-surface shapes at the corresponding times and Froude numbers are found to be in reasonable agreement. The new instability will form the basis of future investigations.

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AN APPROACH TO LOW TEMPERATURE HIGH STRAIN RATE
SUPERPLASTICITY IN ALUMINUM ALLOY 2090

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Successful study of processing, microstructural development and superplasticity in Al-Mg alloys has been extended to the Lithium containing 2090 alloy. Attainment of superior superplastic response in the 2090 alloy has proven more difficult. Successive reductions in the temperature at which rolling was conducted have resulted in moderate improvement to superplastic response. Modification to the rolling schedule has resulted in a continuously increasing strain rate during rolling while recovery temperature and rolling speed are unaltered from previous work.

AUV DIVE CONTROL SYSTEM DEVELOPMENT INCLUDING SENSOR
BIAS COMPENSATION AND PARAMETER ESTIMATION

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The U.S. Navy and a number of its contractors are presently developing unmanned miniature submarines for several vital underwater missions. These include surveillance, submarine tracking, and bottom mapping. Foregoing Research at NPS produced a "testbed" as a research platform for demonstrating the performance of AUVs. Combining the power of an IBM PC/AT in conjunction with a high level programming language, a state space dive control system was developed and instituted for the 30 inch AUV model. Parameter Estimation using a Recursive Least Squares Fit scheme and a State Observer were incorporated in the controller. Procedures dealing with hardware/software interfacing, AUV simulation analysis, and computation speed of large programming code were investigated.

MODELING TRANSIENT THERMAL BEHAVIOR
IN A THRUST VECTOR CONTROL JET VANE

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An attempt was made to model the transient thermal response of jet vanes used for thrust control. A simple computer model based on lumped capacitance methods using boundary layer convection and stagnation point heating as thermal inputs appeared to adequately predict temperatures for a quarter-scale model. The report details the attempt to enlarge the model to allow comparison between thermal predictions and the results of tests on a full-scale prototype jet vane. It was determined that the model could not be considered a thermal representation of the full-scale vane assembly and several modifications were identified in order to adapt the model to full scale applications.

A COMPARISON OF CuAlNi AND OTHER HIGH DAMPING ALLOYS
FOR THE PURPOSE OF NAVAL SHIP SILENCING APPLICATIONS

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Five high damping alloys, including TiNi, CuAlNi, CuZnAl, CuMn, and FeCrMo, were heat treated to produce optimum damping conditions. The strain dependence of specific damping capacity was established using the resonant dwell technique. The results were compared with those of past investigations. For the CuAlNi alloy, six different heat treatment conditions were considered. The CuAlNi specimens were cold worked to determine the effect on damping. An industrial survey was conducted to determine the practicality of shipboard application of these alloys. A comparison of the advantages/disadvantages of each alloy was accomplished and recommendations were made for further study.

DESIGN AND INVESTIGATION OF A DIVE PLANE SLIDING MODE
COMPENSATOR FOR AN AUTONOMOUS UNDERWATER VEHICLE

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A sliding mode compensator for depth control of an autonomous underwater vehicle (AUV) using depth feedback only is designed. The controller is evaluated for a nominal linear model and optimized by a series of numerical experiments for a number of depth changing maneuvers. A state observer is used in order to estimate the unmeasurable states together with the sliding mode controller The effects of varying control parameters are discussed. Compensator performance is assessed by numerical simulation of AUV dynamic response based on the full six degrees of freedom nonlinear equations of motion. The expected robustness of the design is demonstrated by comparison between linear and nonlinear vehicle response characteristics, and by a wide variation in vehicle parameters and hydrodynamic coefficients. Finally, suggestions for design improvement and directions for future research are indicated.

LITHIUM CONCENTRATION DEPENDENCE OF CREEP
IN BINARY ALUMINUM-LITHIUM ALLOYS

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An investigation was conducted into the concentration dependence of creep in binary Al-Li alloys. Constant true-stress creep and constant extension-rate stress-strain tests were conducted at temperatures ranging from 250* C to 500* C. Optical microscopy demonstrated that subgrains formed during deformation and that the predominant physical processes in the creep of Al-Li alloys appears to be dislocation climb, with Lithium providing strengthening by its effect on the modulus or the stacking fault energy.

NATURAL CONVECTION COOLING OF A 3 BY 3 ARRAY RECTANGULAR PROTRUSIONS IN AN ENCLOSURE FILLED WITH DIELECTRIC LIQUID: EFFECTS OF BOUNDARY CONDITIONS AND COMPONENT ORIENTATION

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An experimental investigation of natural convection immersion cooling of two configurations of discrete heat sources in an enclosure filled with Fluorinert FC-75 has been conducted. A three by three array of rectangular protrusions was employed. In the first study, using the same equipment set-up of Benedict [Ref. 13], the influence of changing the enclosure bottom surface boundary condition on flow patterns and heat transfer characteristics was examined. Both insulated and uniform temperature boundary conditions were considered. In the second set of experiments, a new chamber with the protrusions oriented vertically was assembled and effects of component orientation on the heat transfer characteristics were examined. In addition, timewise variations of temperature in several locations were measured and interpreted at different power levels.

STUDY OF VORTEX ARRAYS INDUCED ARTIFICIALLY AND FROM CENTRIFUGAL INSTABILITIES

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Experimental results are presented which describe the development and structure of: 1) vortex pairs and vortex arrays which are embedded in turbulent boundary layers, and 2) vortex arrays developing as a results of centrifugal instabilities in a curved channel. Streamwise vortex pairs embedded in a turbulent boundary layer on a flat plate are induced artificially using vortex generators. Mean velocity surveys, total pressure surveys, and wall heat transfer distributions show that Stanton numbers are augmented when vortex pairs have a common downwash. With common upwash, the Stanton number perturbation from vortex pairs is much less. Vortex arrays induced from centrifugal instabilities were studied in 40:1 aspect ratio channel with mild curvature. Mean velocity and total pressure surveys for Dean numbers from 50 to 150 illustrate some structural characteristics of vortex pairs.

A STUDY OF THE THERMAL PROFILES DURING AUTOGENOUS ARC WELDING

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The three dimensional transient temperature variations during autogenous Gas Tungsten Arc Welding are determined. The model employs a combination of unequally spaced moving meshes to minimize the total number of nodes. Finite differencing is used for the spatial terms. The resulting ordinary differential equations for the transient evolution of thermal transport are solved using the fourth order Runge-Kutta technique. The temperature dependent thermal properties and latent heats of phase transformations are accounted for. Computations are carried out for a rectangular parallelepiped, with convective and radiative surface thermal conditions. These are next compared with variations obtained due to defects such as weld track misalignment and inclusions. A study of the startup and shutdown transients makes it possible to control the cooling rate during these transients. The potential use of this model in the development of an expert welding system using infrared imagery is indicated. In addition, a low cost infrared detector using an indium-arsenide diode is prototyped to determine its feasibility for production welding control.

MASTER OF SCIENCE
IN
METEOROLOGY

APPLICATION OF THE LAGGED-AVERAGE TECHNIQUE
TO TROPICAL CYCLONE TRACK PREDICTIONS

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The lagged-average forecast (LAF) technique applied to tropical cyclone track prediction is a weighted sum of recent forecasts that were started from initial conditions at various times lagging the start of the forecast period. The goal of this study is to reduce the track forecast error at t + 24 h. Two tests of the LAF approach are presented to demonstrate feasibility. The first test uses the nine CLIPPER forecasts initiated at 24, 30, 36, 42, 48, 54, 60, 66, and 72 h prior to the common verifying time. In this test, the mean 24-h forecast error is reduced by 8% relative to the 24-h CLIPPER forecast above. In the second test, the "modified" LAF involves only the five CLIPPER forecasts initiated at 24, 36, 48, 60 and 72 h prior to the varying time. However, the 36-h through 72-h CLIPPER forecasts are first modified using statistical regression equations that include predictors related to new track information since these forecasts were initiated. Significant reductions in the track forecast error results from these statistical adjustments. The modified LAF applied to an independent sample results in a reduction from 189 km to 124 km in the mean 24-h forecast error or a reduction of 34%. This is a significant improvement because the JTWC mean 24-h forecast error for the last four years is approximately 210 km. The standard deviations are significantly reduced from 118 km to 69 km. Because the combination of the modified CLIPPER forecasts in the LAF technique results in a significant improvement in performance, it is recommended that this techniques be applied operationally and also be tested with dynamical models.

A DESCRIPTION OF TROPICAL CYCLONE RECURVATURE
IN TERMS OF ISENTROPIC POTENTIAL VORTICITY

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Isentropic potential vorticity (IPV) fields calculated from the Navy Operational Regional Atmospheric Prediction System are analyzed to determine their usefulness as an aid to tropical cyclone recurvature forecasts. The IPV fields associated with Typhoon Nelson are calculated on a 80 km grid for the period 0000 UTC 4 October to 0000 UTC 7 October 1988. In this preliminary study, IPV advection fields and the horizontal and vertical structure of the bogus vortex are examined to determine their contributions to the model forecast. The extremely broad bogus vortex is found to distort the IPV, which is believed to result in inertial instability. Approximately 36 h are required for the model to adjust to the initial imbalance in the mass and wind fields. It appears that the unrealistic bogus vortex representation may have degraded the early portions of the model forecast. Analysis of IPV advection fields each 12 h during the NORAPS model integration showed that storm movement is primarily due to the influence of self advection and the large scale steering flow. During later periods other advective features associated with adjacent synoptic systems begin to influence the storm movement. Forecaster with access to IPV fields may be able to evaluate the likely validity of the model forecast of recurvature. The usefulness of the IPV representations from the NORPAS prediction in this single case study suggest that additional cases of tropical cyclone recurvature be examined in terms of IPV concepts.

DYNAMICS OF AN ERICA CYCLONE
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Cyclogensis is studied during Intensive Observation Period (IOP) 2 from the Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA) conducted in Winter 1988-89. The detailed synoptic discussion outlines the development of multiple cyclones in the Western North Atlantic Ocean. The surface analyses with data included from ships, buoys, and East coast U.S. land stations resolve a dramatic rapid development case with a deepening rate of 30 mb/12h. A comparison of observed events with operational NMC Nested Grid Model and Global Spectral Model forecast revealed skillful overall performance, however there were some deficiencies in handling details of the cyclogenesis event. Diagnostics of the case show destabilization occurring during the pre-cyclogenesis period and strong upper level forcing for the rapidly developing center.

SYNOPTIC FORCING OF EAST ASIAN COLD SURGES
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A linearized, global spectral model with 8 levels was used to determine whether the nonlinear interaction between a planetary scale wave (wavenumber four) and a rapidly growing synoptic scale wave (wavenumber seven) could produce a northeasterly wind, characteristics of East Asian cold surges. The amplitude of the synoptic scale wave, or generic cyclone, was produced by a nonlinear Eddy model of the atmosphere that included friction. The resulting nonlinear forcing was applied to either the first law of thermodynamics, the vorticity equation, or both. The thermal forcing did not produce a significant cold surge response. The vorticity forcing produced a respectable cold surge within 48 hours. The results of this study indicate the planetary-synoptic wave interaction is a possible method for initiating East Asian cold surges.

SEMI-LAGRANGIAN, SEMI-IMPLICIT SOLUTIONS OF
THE SHALLOW WATER EQUATIONS IN ONE DIMENSION
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The semi-Lagrangian, semi-implicit method is used to model the one dimensional shallow water system of equations which surface topography. The forecast is compared to finite difference and semi-Lagrangian, Explicit forecast. In the first experiment, a nonrotating system is considered. The semi-Lagrangian, semi-implicit model agrees very well with hydraulic jump theory, while the semi-Lagrangian, explicit model exhibits excessive smoothing and the finite difference model breaks down when the nonlinear interactions become too large. In the second experiment, the system is allowed to rotate to examine the effect of rotation on the formation of topographically included hydraulic jumps. Although further study is necessary, it is clear that rotation retards the development of the low pressure to the lee of the obstacle. A larger domain and higher spatial resolution are needed for more detailed simulation of hydraulic jumps.

CORRELATION OF ATMOSPHERIC OPTICAL TURBULENCE
AND METEOROLOGICAL MEASUREMENTS

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The correlation of meteorological events such as the jet stream, gravity waves, and boundary layer circulation with the optical turbulence parameters, the transverse coherence length or and the isoplastic angle O_0 is essential for interpreting and forecasting imaging and laser system performance. In support of the United States Air Force Relay Mirror Experiment, the Naval Postgraduate School performed a series of six site characterization measurements near Kihei, Maui, during August 1987 to July 1988. Spatial and temporal summaries of atmospheric events corresponding to the optical remote sensor data are presented using meteorological data form the National Weather Service Radiosonde Observation station, synoptic charts, GOES-WEST infrared satellite images, and four Kihei, Maui rawinsonde datasets. To quantify the correlation between optical turbulence measurements and meteorological phenomena, four methods of calculating C2T from rawinsonde data were investigated. Results show that existing rawinsonde system are inadequate for direct C2T calculation. However, moderate improvements in the vertical resolution, the temperature solution and probe response time, will allow direct calculations of optical turbulence parameters from rawinsonde data.

MASTER OF SCIENCE
IN
METEOROLOGY
AND
OCEANOGRAPHY

SATELLITE SIGNATURES OF RAPID CYCLOGENESIS

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Animation of satellite visual and infrared imagery indicates that rapid cloud growth is a characteristic of explosively deepening cyclones. The working hypothesis in this thesis is that the intense vertical motions responsible for the low level spin up will produce rapid cloud expansion in the upper troposphere that can be detected using digital satellite data. Using digital IR data form GOES-WEST, the cloud growth of three explosive storms that developed over the Eastern North Pacific Ocean were measured quantitatively and compared with the cyclone deepening rate. The results indicate that the growth in areal coverage of cloud colder than -45 degrees C is most closely related to the explosive development period while the growth of the warmer cloud tops is related to the open wave state. This relationship is dependent on the cloud pattern of the maturing cyclone. Correlations between cloud growth and pressure deepening were calculated, but provide only a general estimate of the relationship between the two parameters. This study demonstrates the feasibility of using digitized satellite data to quantitatively analyze the cloud growth and structure of explosively developing cyclones.

STUDY OF CURRENT ALONG THE POINT SUR TRANSECT

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Ocean currents and density were measured off Point Sur. CA. in February 1989 using Pegasus (an acoustically tracked velocity profiler), ADCP (a ship-mounted acoustic doppler current profiler), and CTD (conductivity, temperature, depth profiler). Absolute velocities are compared with geostrophy and various flow regimes are analyzed with respect to prominent features and historical and other recent data. Geostrophic cross-sections based on various levels of no motion (LMN) are compared. Temperature, salinity, and density fields are examined and correlated to velocity features. The California Current is a weak (<5 cm/s) Southeastward flow starting about 60 km from the coast. The Davidson Inshore Current is a strong (>25 cm/s) surface intensified core of warm, fresh water centered 30 km offshore, and located in the top 100 m. A subsurface maximum of Westward flow exists in a well defined jet 100 m deep about 30 km off Point Sur. There is a trench jet located along the bottom between the continental slope and a seamount 33 km from the coast, which could either be topographically steered out of Monterey Canyon or recirculated from further offshore. A band of alternating meridonla velocity shears is seen in geotropic sections (based on CTD data) 45-100 km form the coast, not supported by other data, and seems to be located in deep water near the edge of the continental margin., Its position in the water column can be shifted vertically by applying various LMSs, but based on density sections and ADCP data it appears to be a feature limited to the water below 1500 m. Otherwise, a 1000 m level of no motion seems to produce the best cross-section of geostrophic velocity.

CORRELATION OF AVHRR IMAGERY WITH SUB-SURFACE FEATURES IN THE CALIFORNIA CURRENT

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SST fields derived from AVHRR imagery are compared with subsurface temperature and surface dynamic height fields. The in-situ collection was part of the Coastal Transition Zone (CTZ) cold filament experiments of 1987 and 1988. The results of the 1987 cruise show a subsurface maximum in the correlation coefficient between AVHRR SST and in-situ temperature at depth for all three phases of the cruise which is attributed to the temporal offset between the satellite image and the data collection. The results of the 1988 cruise show maximum correlations at the surface with significant correlations at the 95% level of confidence to about 130-150 m depth, with positive correlations to 310-350 m depth. Comparing the results of the 1987 and 1988 cruises shows that the offshore filament was much stronger both horizontally and vertically for the latter cruise.

SURFACE CIRCULATION ASSOCIATED WITH THE MINDANAO AND HALMAHERA EDDIES

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During June and July 1988, an AXBT survey was conducted Southeast of Mindanao, Philippines in conjunction with CTD sections completed along the coast of Mindanao. Simultaneously, six Lagrangain drifters were launched in the Mindanao Current. Analysis of the data indicated a highly dynamic and complicated circulation which forms the origin of the North Equatorial Concurrent. Strong shears are observed across the Mindanao current and across a current located on the Northeast coast of Borneo, and based on water mass characteristics and Lagrangain data, the general positions and strengths of the Mindanao and Halmahera Eddies.

THERMODYNAMIC AND DYNAMIC PROCESSES IN THE UPDRAFT REGION OF GALE IOP9

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A detailed diagnostic examination of the warm frontal region ahead of the surface cyclone in Intensive Observation Period (IOP) 9 of the Genesis of Atlantic Lows Experiment (GALE) is conducted. Data for this study consists of normal synoptic observations and special GALE observations, analyzed by the Navy Operational Regional Analysis and Prediction System (NORAPS), which uses optimal interpolation. These analysis are enhanced by hand-drawn fronts and cloud outline from Geostationary Operational Environmental Satellite (GOES) imagery. Symmetric stability is evaluated on cross-sectional analyses of pseudo-absolute momentum and equivalent potential temperature, and reveal conditions of moist symmetric neutrality in the warm frontal region. The planetary boundary θe budget is examined to determine what processes heated and moistened the region. Surface heat and moisture fluxes were found to contribute to significant θe increases only in the early stages of development. Upper level divergence and surface frontogenesis are studied to determine that during the period of explosive development, upper level forcing was unfavorable for development. Low level frontogenetical forcing in the presence of symmetric neutrality was found to be strong enough to oppose this negative upper-level forcing to force rapid developing.

A CASE STUDY OF EXPLOSIVE CYCLOGENSIS IN THE
EASTERN PACIFIC OCEAN 14-17 DECEMBER 1987

Jan Curtis
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An explosive cyclogenesis event occurred in the Eastern Pacific Ocean on 14-17 December 1987 is investigated using the National Meteorological Center (NMC) final analysis and Geostationary Operational Environmental Satellite (GOES) digital imagery. Forecasts for this cyclone by the Navy Operational Global Atmospheric Prediction System (NOGAPS 3.0) and NMC Nested Grid Mesh (NGM) forecasts initialized at 12 UTC 14 December are also evaluated. Quasi-Langrangian budgets of mass and vorticity are computed to understand the factors responsible for the development of this intense cyclone. The initial surface development occurs within a strong baroclinic southeast of a significant short-wave trough aloft. Rapid intensification is accompanied by large cyclonic vorticity advection in the upper troposphere as the surface cyclone moves under the divergent quadrant of a 250 mb jet streak. A key element in this development is the superposition between the pre-existing surface low and upper level short-wave trough in a favorable weak static stability environment. These observations support earlier studies that upper level forcing acts as a critical catalyst in initiating eastern ocean explosive development.

ANALYSIS OF FOREST FIRE SMOKE USING SATELLITE IMAGERY

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NOAA-9 AVHRR data from 17 and 18 September 1987 were used to perform forest fire smoke analysis and tracking. The analyses included alignment, subtraction and division of image digital values to produce an Aerosol Particle Size Index (S12) after Frost (1988). S12 provides information about the slope of the aerosol particle size distribution curve and can be used to infer particle size distribution changes over time. The results provide evidence that the smoke aging process may be successfully studied using satellite imagery, provided careful analysis and removal of background effects are performed.

THE VARIABILITY OF THE MARINE ATMOSPHERIC BOUNDARY LAYER
IN THE GREENLAND SEA MARGINAL ICE ZONE--A CASE STUDY

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The vertical structure of the atmospheric boundary layer in the East Greenland Sea/Fram strait marginal ice zone (MIZ) is examined by various wind flow regimes with respect to the ice edge. Rawinsonde profiles and surface observations collected from three ships during MIZEX-87 (20 March - 11 April 1987) served as the data set for the examination. Three specific flow regimes are discussed: on ice flow, off ice flow, and flow parallel to the ice. On-ice resulted in deep, moist mixed layers capped by high weak inversions, with specific humidity interest within an elevated lower tropospheric layer and dry regions near the surface and aloft. Parallel flow led to the development of strikingly different boundary layer regimes separated by the ice edge: Over ice, Deep surface and elevated inversion were associated with alternating moist and dry layers in the lower troposphere; over water, multiple elevated inversions were associated with an elevated lower tropospheric moist layer and dry regions near the surface and aloft. Possible physical processes important for the development of the observed features are discussed.

EFFECTS OF CLIMATOLOGICAL AND TRANSIENT WIND FORCING ON EDDY GENERATION IN THE CALIFORNIA CURRENT SYSTEM

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A high resolution, multilevel, primitive equation ocean model is used to examine the response to transient and climatological wind forcing of an idealized, flat bottomed oceanic regime on a B-plane, along an Eastern boundary. An annually periodic wind forcing function with zonal variability is used as transient forcing in several experiments using both winter and summer initialization. When the curl component of the forcing is stronger than the stress, as in the wintertime, a surface poleward flow develops in the nearshore region with an equatorward flow offshore. When wind stress dominates the forcing, as in the summertime, a coastal jet develops with an undercurrent. In other experiment, spatially varying one degree and two tenths degree steady wind stress data are used at the climatological forcing. The one degree steady wind stress data are used as the climatological forcing. The one degree climatological wind stress data has positive curl at the coast which causes a poleward surface flow to develop. When two tenths degree wind stress data is used in the nearshore area, both positive and negative curl in the coastal region result in the formation of poleward and equatorward currents, respectively. As a results of convergence in the surface flow, eddies and a well defined cold filament develop. These results show that the interaction of diverse coastal current driven by an equally diverse wind field can play an important role in the production of cold filaments and eddies.

CLOUD REFLECTANCE CHARACTERISTICS IN THE PRESENCE OF VARIABLE DIMETHYSULFIDE (DMS) SOURCES

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Oceanic dimethysulfide (DMS) sources are inferred from silicon anomaly information in the Denmark Strait during June 1984. This June 1984 "bloom" of the phytoplankton species Phaecytes pouchetti, a know DMS producer, is compared to the "non-bloom" of June 1982 using NOAA-7 AVHRR data from channel 1 (.63 um), color enhanced data for each individual day, composites for June 1982 and June 1984 are created for channel 1 and channel 3 wavelengths. These composites eliminated day to day differences in reflectances by averaging data which were neither cloud free nor high cloud contaminated. Based on these composites, evidence is presented which suggests that a correlation exists between inferred DMS source regions and higher reflectance values at channel 3 wavelengths.

GLOBAL SCALE ESTIMATES OF AEROSOL PARTICLE CHARACTERISTICS

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NOAA-7 AVHRR data from April 1982 and 1983 were used to perform a global scale analysis of aerosol particle characteristics. Several improvements were incorporated into an AVHRR multichannel satellite data technique developed by Pfeil (1986). This included better cloud and sunlight discrimination, removal of Rayleigh radiance and accounting for ozone absorption. The characteristics analyzed were optical depth and Aerosol Partial Size Index (S12). S12 provides the slope of the aerosol particle size distribution curve. Both of these parameters were evaluated during several naturally occurring events, foremost of which were the 1982 El Chicon eruption and the 1982-1983 El Nino-Southern Oscillation event. The results provided evidence that a significant amount of aerosol particles over Marine regions are from land-derived sources. However, the results also provided evidence that some Marine aerosol particles may be of biogenic origins.

PREDICTABILITY OF ICE CONCENTRATION ANOMALIES IN THE HIGH LATITUDES OF THE NORTH ATLANTIC USING A STATISTICAL APPROACH

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Based on a 27 year data record from the COADS and SEIC data sets, a statistical analysis of ice concentration, sea surface temperature (SST), air temperature, U and V wind components, and sea level pressure anomaly data was conducted for five locations in the ice-covered waters of the North Atlantic. Spectral densities and autocorrelations of the time series for each variable were calculated to establish a measure of persistence and periodicity. Regression equations were formulated based on the above data sets to the forecast both the winter and summer ice concentration anomalies for each loca-tion. The differing effects of land and ice boundaries, currents, storm passages and wind velocity anomalies on the ice concentration anomalies at each location were reflected by the parameters retained by each of the regression equations. In addition to ice concentration anomalies at various lags, the inclusion of meteorological and oceanographic parameters was shown to increase the total explained model variance, which should improve the accuracy of an ice concentration anomaly forecast at lead times of a least one season over a forecast based on ice concentration anomaly persistence alone.

POSSIBLE CONTRIBUTIONS OF LID CONDITIONS DURING CYCLOGENESIS

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Maritime soundings acquired during the Genesis of Atlantic Lows Experiment (GALE) Intensive Observing Periods (IOP's) 6 and 11 are evaluated to determine the presence of midtropospheric, dry continental air that forms a capping inversion over cool, moist Marine Air, which is defined to be a lid. The strength of these lid conditions is evaluated using the Lid Strength Index (LSI) developed by Carlson al. (1980) for continental thunderstorms. The environmental factors contributing to lid conditions and the lid's possible effects on explosive cyclogenesis are analyzed. During IOP 6, a predominantly zonal flow advects warm, dry continental air over the region upstream of the convective heat release. Consequently, the air-sea fluxes and the horizontal advection of moist air into the central region of the low are trapped below the lid. With the superposition of upper-level forcing that lifts and weakens the lid, the IOP low develops explosively. During IOP 11, the mid tropospheric air flow is more meridional and no lid conditions occur upstream from the cyclone region. Consequently the air sea fluxes and horizontal advection of moisture is not confined to the lower troposphere. Although cyclogenesis occurs in this environment, it is not explosive. The presence of lid conditions during IOP 6 and the absence of lid conditions during IOP 11 are suggested to be one of the factors that differentiated explosive and non-explosive maritime cyclogensis.

SALINE IMPACT ON THE CALIFORNIA CURRENT SYSTEM

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There are some indications that in large measure the density anomaly field of the California Current System (CCS) follows temperature, salinity playing a significantly lesser role. These indications have been used as justification for ignoring salinity variations in dynamic models. An extensive data base for simultaneous temperate salinity observations taken in the CSS is used to calculate the Saline contribution to specific volume anomaly, dynamic height, and density variance. The results show that the distribution of salinity can be important in defining the large scale circulation of the CCS, and that the local variability can be quite significant.

A NUMERICAL STUDY OF RAIN-INDUCED
SURFACE GRAVITY WAVE ATTENUATION

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Strong rain induced mixing in a thin surface layer is numerically shown to greatly increase surface gravity wave attenuation. The case study uses a single wavelength (2.8 m) together with two mixed layer depths (10 and 20 cm). The rain-induced mixing is simulated by varying kinematic viscosity within the mixed layer from 10^{-6} to 10^{-2} m2 s-1 molecular to strong turbulent mixing, respectively. The results indicate that surface gravity wave attenuation in the presence of a thin rain-induced mixed layer can increase by a factor of up to 6000 times the attenuation rate due to molecular viscosity alone. This indicates that rain need only mix the top 10-20 cm surface layer to effectively dampen short surface gravity waves.

A RANGE-DEPENDENT ANALYSIS OF ACOUSTIC TRANSMISSION
ACROSS A COLD FILAMENT IN THE CALIFORNIA CURRENT

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CTD data were taken in a area where satellite imagery had detected a cold water filament to frequently recur in the California Current System in order to determine the temporal and spatial variability of the hydropic and velocity fields. Sound speed profiles were constructed from this data and predicted sonar ranges (PSRs) were computed for passive sonar using a range-dependent parabolic equation model. Analysis of model results applied to tactical scenarios showed the acoustic advantage between two adversaries to change as their positions relative to the front and to each other were changed. An investigation of the acoustic mechanisms involved in the variations in surface temperature were enough to cause significant changes in PSRs. Changes in temperature of sufficient magnitude to effect PSRs were found also in SST imagery of cold filaments in other easter boundary currents around the world.

A PROTOTYPE EXPERT SYSTEM TO FORECAST SEVERE
WINDS IN THE WESTERN MEDITERRANEAN SEA

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A prototype expert system is designed to forecast severe winds in the Western Mediterranean Sea. The first version of the expert system is to nowcast levant conditions in the Strait of Gibraltar and to nowcast/forecast mistral conditions in the Gulf of Lion. Rules of thumb for these events from the "Handbook for Forecasters in the Mediterranean" (Brody and Nestor 1980) are tested with observations during the period September 1988 through February 1989. Of the 19 rules list in the handbook for levant, five are used in the expert system without modification, six are modified and eight are discarded. Of the 41 rules for the mistral, 14 are used without modification, two are slightly modified and 25 are eliminated. The first step in each case is to select adjacent land stations whose observations best infer the presence of the gale wind conditions over the open seas, where in situ observations are not available. The basic approach in the expert system is to provide an ordered sequence of rules (based on the verifications during the six month period) that the forecaster can continue to test until a forecast decision can be made with confidence. Operational testing is needed to refine the severe wind algorithm, which can easily modified to include more empirical rules from expert forecasters in the future.

A COMPARISON OF PEGASUS AND COMBINED CTD/ADCP CURRENT PROFILES OFF THE CALIFORNIA CURRENT

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Vertical profiles of alongshore and cross-shore velocities obtained by PEGASUS, a free-falling acoustically tracked current profiler, and an Acoustic Doppler Current Profiler (ADCP) are compared. Data was collected during November, 1988 near Point Sur, California. Processing of data for both instruments is discussed in some detail. Velocity profiles and contours show good correlation in feature location, but often differed significantly in intensity. Alongshore velocity components from the two instruments were more highly correlated than were cross-shore component. Alongshore velocities also agreed well with both geostrophy and historical data.

A CASE STUDY OF JAPANESE COASTAL FRONTOGENESIS

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Coastal frontogenesis, which has been extensively studied off the east coast of the United States, proves to be an operational forecasting problem as well as possible link to explosive cyclogenesis. Similar conditions that produce coastal fronts along the U.S. coast also exist over the Western North Pacific Ocean of the coast of Japan. However, few studies have examined the mesoscale coastal phenomena that precede Asian coastal cyclogenesis. Therefore, a synoptic and mesoscale analysis was completed for an areas near Tokoyo Japan prior to a 23 March 1986 explosive cyclogenetical event. Synoptic scale analyses fail to pick up the details of any possible coastal frontogenesis. Results from the mesoscale analysis indicate that convergence and frontogenesis begin along the 24 hours prior to the cyclogenesis. The coastal frontogenesis seems to begin just inland as discrete regions of frontogenesis and then move offshore as a more or less continuous feature just prior to the passage of the cyclone. Imagery form the Japanese GMS satellite supports the sequence of events suggested by the mesoscale analyses. However, future studies will need a more complete data network especially over the water to further characterize this mesoscale phenomenon.

A CORRELATION STUDY OF WIND SPEED AS MEASURED BY THE SPECIAL SENSOR MICROWAVE/IMAGER AND THE GEOSAT ALTIMETER

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Wind speed data is routinely acquired at the Fleet Numerical Oceanographic Center (FNOC) in near real time from the Special Sensor Microwave/Imager (SSM/I), on board the Defense Meteorological Satellite Program (DMSP) satellite and the Radar Altimeter on board the GEOSAT satellite. A correlation study is made of the SSM/I and Altimeter wind speed data using five data sets from areas where the DMSP satellite had crossed within 1.1 hours of the GEOSAT satellite. Regions of ocean where the atmosphere was free of cloud water and precipitation have high correlation of approximately 0.995, while areas with precipitation and cloud water have very poor correlation. Areas of high water vapor content do not appear to adversely affect the high correlation between the SSM/I and ALTIMETER measured wind speeds.

A NUMERICAL STUDY OF A MESOSCALE EDDY INTERACTION WITH AN OCEAN FRONT IN THE MARGINAL ICE ZONE

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The East Greenland Current and its associated Marginal Ice Zone is a region of intense dynamical activity. A two layer, primitive equation, numerical model is used to simulate an eddy-jet interaction in the East Greenland marginal ice zone region. The effects of wind direction, topography, and sense of eddy rotation on the eddy-jet interaction are examined to determine the seaward ice transport, icebanding, and dipole formation. It is determined that an anticyclone (15 cm/s) interacting with a jet (30 cm/s) will develop a dipole that advects ice away.

The dipole formation and ice advection away from the ice edge is not seen for a cyclone-jet interaction. It also seen that a jet with no winds flowing parallel to the ice edge will create an iceband due to the cross ice edge Ekman transport. The interaction of both the cyclone and anticyclone with the jet creates downstream perturbations in the jet leading to a sinuous ice edge. Winds greater than 10 m/s dominate the ice dynamics over that induced by the ocean flow fields.

NEAR REAL TIME VHF TELEMETRY OF NEAR SHORE OCEANOGRAPHIC DATA

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This thesis reports on the development and tests of a low cost automated telemetry system. This system daily transmits the last 24 hours of collected data from a near shore moored buoy system. Investigation into the different telemetry modes resulted in selecting a very high frequency (VHF) narrow band frequency modulation (NBFM) packet networking system. The telemetry system features line of sight propagation, resistance to radio interference and included a digital error checking routine. The equipment used in the VHF NBFM packet is light weight, has low power consumption and inexpensive when used with commercially available amateur radio equipment. Test of a prototype suggest that a VHF NBFM packet system is a practical tool for near shore buoy telemetry of in situ oceanographic data.

A NUMERICAL STUDY OF TOPOGRAPHICALLY STEERED FLOWS IN THE FRAM STRAIT

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The Fram Strait is a region of complex circulation and intense dynamical activity. Its general circulation is largely influence by the East Greenland Current (EGC), the associated Marginal Ice Zone jet, the West Spitzbergen Current (WSC) and the topography of the region. The general circulation was studied using a two layered numerical model. Forcing of the model was done by varying: the inflow and outflow velocity; the port locations and boundary conditions; and by adjustment of topography. Representative topography of the Fram Strait was modeled in the lower layer. Results indicate that the model is sensitive to EGC width and its proximity to the western boundary; and that in the absence of EGC flow, the Return Atlantic Current does not exist. Investigation of model sensitivity to WSC inflow vertical shear led to the conclusion that when the WSC inflow is 10 cm/sec in the upper layer and 5 cm/sec in the lower layer, a boundary trapped component of the WSC is generated.

AN ANALYSIS OF HYDROGRAPHIC DATA COLLECTED
OFF POINT SUR, CALIFORNIA IN NOVEMBER 1988

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Velocities measured by Pegasus and an Acoustic Doppler Current Profiler over a zonal section off Point Sur, California in November 1988 are compared. The inertial motion component of the total flow are determined, examined and removed from the Pegasus velocity cross sections by using cast separated by half an inertial period. Results of the processing techniques show excellent agreement between profiles measured by the instruments with correlation coefficients of 0.948 and 0.875 obtained for the U and V component velocities, respectively. Observations of the oceanography of the section are made by three different instruments: 1)Pegasus, an acoustically tracked float, which provides surface to bottom velocity information, 2) a ship mounted ADCP which provides continuous profiling of the upper ocean, and 3) a CTD which provides surface to bottom continuous measurements of pressure, conductivity, and temperature. From these instruments sections are constructed and conditions described. The following flows are observed: 1) A nearshore coastal trapped poleward flow which is confined to within the 100 fathom isobath, and which strengthens during relaxation events. 2) An equatorward flow occupying the outer shelf and inner continental slope, which during relaxation events widens and extends farther offshore. Between this flow and the nearshore poleward flow a strong shelf break front is observed with a shear of 1.5 x 10-4 s-1 and a width of 3 km. 3) West of the equatorward flow located between 50 and 65 km offshore in the mid-continental slope region the California Undercurreny is observed. It is located farther offshore during relaxation events and weakens with distance offshore. 4) Farther offshore (approximately 100 km) and just barely resolved by the data, the California Current is observed. The core of the flow is not resolved, but historically should be located more than 200 km offshore.

MODELING STUDIES OF THE LEEUWIN CURRENT USING
A HIGH RESOLUTION PRIMITIVE EQUATION MODEL

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A primitive equation model is run to investigate generation and instability mechanisms in the Leeuwin Current. The current is generated by the model using a combination of density forcing from the climatological Indian Ocean thermal structure, the influx of warm low salinity water from the North West (NW) Shelf, and the climatological wind stress. The current thus generated is compared with observations taken during the Leewin Current Interdisciplinary Experiment (LUCIE). In the absence of the NW shelf water, which corresponds to the austral spring and summer flow, wind forcing is dominant at the equatorward end of the domain and geotropic flow, driven by the Indian Ocean thermal gradient dominates at the poleward end. This leads to a weak coastal upwelling regime with equatorward and offshore flow at the equatorward end. Further poleward, the stronger Indian Ocean forcing establishes a poleward surface current and equatorward undercurrent which accelerates poleward, into the prevailing wind. The inclusion of NW shelf waters, typical of the austral fall and winter seasons, completely dominates the wind forcing at the equatorward end of the model. The effects of the NW Shelf water weaken away from the source region, but they continue to augment the Indian Ocean forcing, resulting in a stronger flow along the entire coastal boundary. The current generated by the model compares well with available observations. The current also has significant mesoscale variability. An analysis of the energy transfers in the period during which eddies are generated shows barotropic instability to be dominant over baroclinicity in the current forced by instability and leads to an earlier development of eddies. The NW Shelf waters add strong baroclinicity, which weakens poleward, to the current. They also locally increase the barotropic instability near their source. Several scales of eddies are found to be dominant. The forcing by the Indian Ocean and wind stress leads to eddy growth on scales around 385 km. With the inclusion of the NW Shelf waters, the wavelengths associated with mesoscale variability are around 160 km and 330 km after 160 days, consistent with available observations.

AN ANALYSIS OF DIURNAL WIND VARIABILITY IN THE SANTA BARBARA CHANNEL FROM SODAR MEASUREMENTS

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Diurnal wind variability within the atmospheric boundary layer along the coast of the Santa Barbara Channel is studied by spectral analysis of SODAR (Sound Detection and Ranging) wind measurements. Rotary spectral analysis is used to investigate wind circulations and oscillations in the vertical. Power density spectral analysis is used to find frequencies with the greatest amount of kinetic entry. The results show a tendency for counterclockwise rotation in the lowest level and clockwise rotation in the upper levels. Some cases show counterclockwise rotation in all levels. Most of the kinetic entry was concentrated at a diurnal frequency related to local sea and land breezes. However, a secondary kinetic energy maximum is consistently found at a sub-diurnal frequency. The source of this sub-diurnal energy in the vertical may be a mesoscale circulation, such at the Gaviota Eddy or the Catalina Eddy.

CORRELATION BETWEEN SATELLITE-DETECTED AEROSOL CHARACTERISTICS AND OCEANIC DIMETHYLSULFIDE (DMS)

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Oceanic dimethylsulfide (DMS), excreted by phytoplankton in the remote ocean, may be a major source of cloud condensation nuclei (CCN). The process includes the formation of non-sea-salt sulfates. (NSS-SO4-2) which serve as a substrate for CCN. The Earth's mean temperature is sensitive to cloud albedo which is a direct function of CCN concentration. Therefore, regulation of global climate is possible through variations in oceanic DMS measurements. Using two images covering the time periods 20-25 April and 9-12 May 1982, red (Channel 1) and near infrared (Channel 2) ratios are produced using averaging algorithms. Channel 1/Channel 2 ratio values from these images are compared with oceanic DMS measurements observed from the R/V DISCOVERER between 8-21 May 1982 in the central, equatorial North Pacific Ocean. From this comparison, evidence is presented which supports the reaction that oceanic DMS is positively correlated with atmospheric aerosol particles. A slight positive correlation with sea surface temperature and oceanic DMS is also observed.

SATELLITE PRECIPITATION ANALYSIS FOR A
DEVELOPING NORTH PACIFIC OCEAN CYCLONE

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Three satellite based precipitation techniques are used to analyze the precipitation pattern associated with a developing winter cyclone over the Eastern North Pacific Ocean. A visible/infrared technique, developed by the Naval Postgraduate School (NPS), uses cloud-top temperature and albedo thresholds to produce a rain estimate. A microwave method, based on an algorithm made by the Hughes Aircraft Company (HAC), retrieves rain rate estimates based on both the thermal emission at 19 GHz and the scattering by precipitation size ice at 37 GHz. Another microwave technique identifies rain coverage based solely on the high sensitivity of 85 GHz channels to ice scattering above the freezing level. A polarization corrected temperature (PCT) is formulated to isolate the 85 GHz precipitation effect. A subjective evaluation and comparison of the rain estimations are performed. The NPS technique produces representative results within the warm front, but appears to underestimate potential rain associated with the cold front. The HAC retrieval provides a synoptically realistic analysis of the cyclone's rain pattern, but does not resolve the potential precipitation within the isolated, convective clouds behind the cyclone. The PCT method gives a representative coverage of the convective activity within the cyclone and its surrounding area, but does not depict the potential rain areas associated with stratiform clouds.

ON EFFECTIVENESS OF THE PRODUCTION OF
ANTARCTIC BOTTOM WATER IN THE WEDDELL AND ROSS SEAS

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The northward propagation of Antarctic Bottom Water (AABW), from its primary source in the Weddell Sea, has been documented since the early part of this century. Despite the striking similarities between the Weddell and the Ross Seas, AABW is mainly produced in the Weddell Sea. The question is posed as to why the Weddell Sea is so effective in the production of AABW as compared to the Ross Sea. Differences are determined by analyzing various physical mechanisms and forcing functions in both basins with respect to the two predominant theories of AABW formation. Foster and Carmack's shelf break process theory and Foldvik and Gammelsrods's theory of ice shelf processes. Results reveal that the stong tidal forcing at the Weddel Sea ice shelf barrier combines with the wind stress field and with the special under ice shelf and continental shelf bathymetries of the Weddell Sea to become the critical elements of the AABW formation process. The shelf break process theory is found to predict the formation of intermediate or deep waters in both basins. The ice shelf process theory is found to account of the formation of Weddell Sea Bottom Water (WSBW), the parent constituent of AABW, with a prediction of an Ice Shelf Water outflow rate of approximately 0.7 x 106m3s-1 (due to tidal action at the barrier allowing ice production by high surface freezing levels and tidal forcing of sea water under the ice shelf) and a production rate of WSBW of 5 x 106m3s-1 which agrees with observations and current estimates.

STUDY OF EXPLOSIVE AND NONEXPLOSIVE CYCLOGENESIS DURING FGGE

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The purpose of this thesis is to analyze and evaluate explosive cyclogenesis during the winter of the First Global GARP Experiment (January to February 1979). Explosive cyclogenesis is defined as a decrease in the sea level pressure at the rate of one mb per hour for a period of 12 h up to 24 h. The European Center for Medium range Weather forecast (FCMWF) provided the revised analyses for evaluation and comparison of important cyclone properties in a sample of 13 explosive developing cases and eight nonexplosive cases. The specific parameters being examined include the static stability, low level absolute vorticity, vorticity advection, eddy and mean modes of the vorticity transport, upper-level divergence, kinematic vertical velocities and the strength of the low level baroclinity. These parameters are compared at the initial, 12 and 24 hour time periods as well as the overall 24 hour average. The statistical relationships and magnitudes of these terms indicate the most significant physical mechanisms in explosive cyclone development compared to the nonexplosive storm group. The important outcome of these results is the kinematic vertical velocity and the upper-level forcing mechanisms are statistically separable. The large values for the upper level processes suggest that the upper tropospheric wave influence is most likely producing the stronger vertical motions.

MASTER OF SCIENCE
IN
OCEANOGRAPHY

KINEMATICS UNDER WIND WAVES

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The ocean near surface kinematics were measured as part of the SAXON experiment during the period from 5 to 14 October 1988. A growing wave field due to a passing front with winds up to 17 ms-1 occurred during the first 5 days. A wide range of wind forcing and wave conditions occurred during the measurement period. Two orthogonal components of the horizontal velocity were measured using an electromagnetic current meter. The wave directional field was measured using a high resolution 2 meter square slope array. The classical Longuet-Higgins et al (1963) method of computing directional wave spectra and the new exact Fourier coefficients representation method (Grauzinis, 1989) are used to compute directional wave spectra. The new method of computing directional wave spectra, which represents bi-modal distributions of wave energy exactly matching the measured Fourier coefficients to second order, demonstrated improved performance over the classical technique. Phase functions between the sea surface elevation and horizontal velocity components compared well with the results predicted by linear wave theory. The coherence function of the horizontal velocity components and the sea surface elevation confirmed the dependence on the wave field directivity. Spectra of the sea surface elevation computed from pressure and horizontal velocity data compared well using linear theory transfer functions.

TEST AND EVALUATION OF SURF FORECASTING MODEL

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A model forecasting the wave height and the longshore current distribution inside the surf zone based on the formulations by Thornton and Guza (1983), (1986), are applied to an extensive set of both laboratory and field data for the purposes of testing and modification. The models are tested on planar beaches as well as barred beaches for a variety of wave conditions. The wave transformation model is based on solving the energy flux equation using a bore dissipation mechanism and describing the random wave heights with the Rayleigh distribution. The two model parameters B and y, where B describes the amount of foam of a breaking wave and y is the proportionality constant which relates the rms wave height to the water depth, are combined into a single parameter BG. The combined parameter BG is shown to be a function of deep water surf similarity parameter. Applied to the present data sets, the rms error of the measured wave height and the model predicted wave height was usually less than 9% and ranged from 1.5% to 15.7% with a mean of 5.3% and a standard deviation of 3.1% for the whole 74 data sets. The wave transformation model is highly robust in describing the wave height distribution in the surf zone. The longshore current model is based on solving the steady state, alongshore momentum balance for straight and parallel contours using the radiation stress concept. The model requires specifying the bed shear stress coefficient (cf) and turbulent mixing coefficient (N). Applied to the present sets of the rms errors between the measured and modeled longshore current values ranged from 4.5% to 55.5% with a mean of 24.6%. The turbulent mixing is not required for planar beaches, but it is required for barred beaches to describe the longshore currents inside the surf zone. The mean value of the bed shear stress coefficient for the present longshore current data is 0.006 and the mean lateral mixing coefficient is 0.006.

A NUMERICAL STUDY OF WIND FORCING IN THE
EASTERN BOUNDARY CURRENT SYSTEM OFF PORTUGAL

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A high resolution, multi-level, primitive equation ocean model is used to examine the response to wind forcing of an idealized, flat bottomed oceanic regime on a B-plane, along the eastern ocean boundary off the west coast of the Iberian Peninsula. Three experiments are conducted to investigate the role of different types of prescribed wind forcing. In experiment 1, a band of equatorward winds which are alongshore, but contain zonal variability (i.e., large negative wind stress curl near the coast), results in an equatorward coastal surface current nearshore and a poleward surface current offshore. With time, the currents become unstable and anticyclonic warm core eddies develop in the region of negative wind stress curl. In experiment 2, the model is forced with poleward wind stress for 20 days followed by a sudden change to equatorward wind stress. A 1-2 day transition from downwelling and a poleward surface current near the coast to upwelling an equatorward surface jet widens and gets shallower nearshore, and the poleward undercurrent moves closer to the surface (depth ~ 120 m at the coast). For experiment 3, a time series of 6 hourly values of the north / south component of wind, computed from Fleet Numerical Oceanography Center synoptic surface pressure analyses are used to investigate the response of the coastal current system to time dependent wind forcing. Equatorward wind events increase the vertical extent and cross section of the surface equatorward jet and reduce the poleward undercurrent. Relaxations reduce the vertical extent of the equatorward surface coastal current, increase the cross sectional area of the poleward undercurrent, and the undercurrent tends to shoal nearshore. Poleward winds displace the equatorward current offshore and create a poleward surface current nearshore. By the middle of the upwelling season, eddies are generated. By the end of the upwelling season (with the seasonal reversal to poleward winds), the eddies and equatorward surface current weaken or disappear and poleward surface current develops nearshore. The results from the experiments support the hypothesis that wind forcing, and particularly time dependent winds, can be a significant generation mechanism for eddies, jets, fronts, and upwelling filaments off the west coast of the Iberian Peninsula.

A STUDY OF THE VELOCITY STRUCTURE NEAR A COLD
FILAMENT FROM ADCP AND CTD MEASUREMENTS

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CTD and ADCP data from the Coastal Transition Zone (CTZ) pilot cruise off Point Arena, California, during June 1987, were combined to make optimal estimates of the current velocity filed. The region was characterized by upwelling over the shelf, a single strong offshore geostropic jet to the north, and a meandering equatorward flow which advected upwelled water from the coastal region up to 150 km offshore. Geostropic velocity profiles referenced to 500 dbar were adjusted to the ADCP measured velocity in the 190-274 m layer. Comparison of the unadjusted and adjusted profile sets showed generally good agreement below 200 m, but marked differences in several of the profiles above 200 m. Sections of geostropic and ADCP velocity indicated that the flow in the region was highly geostropic, but geostropic flow components were also present, particularly in the high velocity regions. Volume transport was computed for a portion of the survey area using the two velocity data set and the Ekamn transport, computed from the observed wind data. Transport in the chosen subregion was not balanced due to 1) rapid temporal changes in the meandering upwelling jet, and 2) the influence of high frequency variability which impacted both the CTD and the ADCP data.

AMBIENT NOISE DUE TO THE SHEARING OF THE BOUNDARY LAYER UNDER SEA ICE

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The generation of ambient noise by physical processes dependent on shearing on the boundary layer under sea ice is investigated. Special attention is paid to the identification of individual noise generating mechanisms and the assessment of their relative importance. Recent studies of Arctic ambient noise are reviewed with specific reference to results showing particularly good or poor correlation between ambient noise levels and ice movement or relative current. Potential noise generating mechanisms are described and categorized according to their small scale driving forces and expected noise characteristics. More detailed quasi-objective investigations are then used to establish the relative importance of each mechanism as a contributor to the overall under ice noise spectrum. Flow mechanical mechanisms, involving ice sheet fracture as a result of wind and current induced bending moments, are found to be unlikely contributors. Conversely, processes in which ice fragments in current driven motion under the ice interact to cause bumping and grinding noises, appear to be of probable importance. Turbulent pressure fluctuations in the boundary layer under sea ice are shown to be of significance at low frequencies on a local scale. The role of resonant cavities in the under surface of the ice does not appear, however, to be an important one.

MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

SCHEDULING TESTS ON THE NAVAL
WEAPONS CENTER RANGE FACILITIES

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Master of Science in Operations Research - September 1989
Advisor: R. Kevin Wood - Department of Operations Research

The Naval Weapons Center (NWC) is the Navy's primary research, development, test and evaluation facility for air launched weapons. As such, its many ranges and associated equipment and personnel are used extensively for the testing of weapons systems. The Scheduling Office within the NWC Range Department is responsible for determining which tests are conducted during each week. Since there are more test requests than time or facilities, the Scheduling Office struggles, by hand, to schedule as many tests as possible. This thesis develops and implements an integer programming model designed to maximize the sum of priorities for test schedules within a weekly master schedule. The X System was used sequentially to solve five daily schedules to produce a weekly master schedule while insuring sufficient resources are available to conduct the tests. The model selected a set of tests and their test times from a pool of fifty tests with 1440 potential schedules. Thirty-eight of the fifty tests were schedules using approximately eight and a half minutes of CPU time on an IBM 3033AP. This is considerably faster than the current manual process which requires and entire day to create a weekly schedule.

SEALIFT EXECUTION SCHEDULING REQUIREMENTS ANALYSIS

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Master of Science in Operations Research - September 1989
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This analysis examines the sealift execution scheduling process with the purpose of identifying factors which require consideration in the development of an automated execution scheduling system. Organizational, communicational, and algorithmic factors are examined and assessed as to importance in scheduler development. From this assessment, a proposed system structure is developed to provide a high level framework upon which further research and development can be built. Recommendations for interim improvement in the process are made as well.

ANALYSIS OF A LANCE MISSILE PLATOON
USING A SEMI-MARKOV CHAIN

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Master of Science in Operations Research - September 1989
Advisor: S.H. Parry - Department of Operations Research

This thesis develops a combat effectiveness model for the Lance missile system. The survivability and ability to accomplish the mission for a Lance missile launch platton depends upon enemy capabilities, platoon configuration, missile reliability and many other tangible factors. The changing status of a launch platoon is modeled using a semi-Markov chain with transient and absorbing states. Expected number of missiles fired prior to absorption and expected time to absorption are the measures of effectiveness used to analyze the effect of scenario input. Sensitivity analyses are conducted on the parameters of platoon configuration, missile reliability and fire point usage.

SIXTH FLEET COMBAT STORES SHIP RESUPPLY MODEL

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Master of Science in Operations Research - March 1989
Advisor: D.R. Henderson - Department of Administrative Sciences

This thesis improves the method of determining inventory levels for commodities (provision, high usage load list consumables, and ships store merchandise) managed by the Sixth Fleet on station AFS. Historical demand generated by ships deployed to the Sixth Fleet is used to develop two models, the Lognormal Model and the Point Estimate Model. Improvement is achieved by considering each item's variance in demand. The Lognormal computes sample standard deviations for each item and provides the more accurate results. The Point Estimate Models uses regression to estimate a standard deviation for groups of items. Although the Point Estimate Model is easier for Hands-on users to understand, it is not easier to implement. The two models are compared against current procedures using a second set of actual Sixth Fleet data to simulate six months of inventory activity. Satisfied customer demands are improved by five percentage points (from 93% to 98%) and end of the month contingency inventory reserves are improved by 30 percentage points (from 65% to 95%).

GRAPHICAL ANALYSIS OF THE SENSITIVITIES OF ATCAL IN THE FORCEM MODEL

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Master of Science in Operations Research - June 1989
Advisor: L.D. Johnson - Department of Operations Research

This is an analysis of an attrition process in the context of its theater model. A graphical data analysis of the sensitivities of ATCAL with respect to FORCEM operational data was performed. Given the ACTAL results from various FORCEM runs, the sensitivity of ATCAL within the FORCEM model to the effects of frontage of engagement and presence of important weapon systems was investigated.

IMPLICATIONS OF THE LAMBDA-SIGMA JUMP MODEL AN OPTIMAL CONTROL THEORY ON TACTICS

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Master of Science in Operations Research - September 1989
Advisor: A.R. Washburn - Department of Operations Research

The effects of optimal control theory and the lambda-sigma model on speed selections are studied. Detection probabilities are calculated over a specified track using speed selected from optimal controls, constant speeds, and a variety of preset speed profiles. Considerations of speed selections given the tradeoff between transit times and probability of detection are addressed.

EVALUATION OF A DISCRETE MODIFICATION OF THE CONTINUOUS AMSAA RELIABILITY GROWTH MODEL

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A new discrete reliability growth model is created by modifying the often used Army Material Systems Analysis Activity (AMSAA) continuous reliability growth model. The new model is labeled the AMSAA-D model. Its accuracy is evaluated and compared with three other existing discrete reliability growth models. The results show the AMSAA-D model is at least as accurate as the other models. In particular, it is more accurate than an AMSAA discrete model which requires computer supported numerical methods to calculate the reliability estimates from test data. The AMSAA-D reliability estimates can be made with a hand-held calculator. Computer simulations were used to generate test data needed for the evaluation. The simulated test plan assumes that repeated tests on a system are performed until a predetermined number of failures occur, at which time a design change is made to the system to improve its reliability growth pattern. Five hundred replications of each growth pattern are simulated. For each replication, reliability estimates are calculated for each of the ten sets of generated test data using equations from search of the four growth models. Average and sample mean square error values across the 500 replications are used to deter-mine accuracy. Sensitivity of the AMSAA-D model to the number of failures before system modifications and to the number of possible failure causes is also evaluated. Results of all evaluations are presented graphically.

VALIDATIONS AND ANALYSIS OF THE ENHANCED NAVAL WARFARE GAMING SYSTEM RELEASE 2 CRUISE MISSILE MODEL

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Master of Science in Operations Research - September 1989
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This thesis is an analysis of the cruise missile targeting and engagement models in the Enhanced Naval Warfare Gamin System (ENWGS) release 2. Flow charts derived directly form the computer code are included. The purpose of this thesis is to analyze the computer code to determine its realism in model ing actual cruise missile engagements and to provide the ENWGS users with insight to the factors affecting cruise missile engagements in the game. Modifications to the Enhanced Naval Warfare Gaming System are proposed. Recommendations are also included for Game Directors using the game.

CONSTRUCTION OF A FORMAL METHODOLOGY TO REFINE A SPARES SUITE USING TIGER

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This thesis proposes a method for setting inventory levels for a suite of spares for a ship subsystem. The method extends the one proposed by Judge and Leutjen [Ref. 1] which uses the TIGER computer simulation model to modify levels of shipboard spare parts that have been determined by a sparing model. By combining TIGER and the Availability Centered Inventory Model (ACIM), a coordinated shipboard allowance list (COSAL) models currently used in the U.S. Navy, our method is able to achieve the same level of operational availability for ship subsystems at less cost.

A PROPOSED ANALYTIC FILTER MODEL FOR USE IN FAADS FORCE MIX ANALYSIS AT THE U.S. ARMY AIR DEFENSE CENTER

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Master of Science in Operations Research - September 1989
Advisor: S.H. Parry - Department of Operations Research

This thesis proposes an analytic filter model to support the Forward Area Air Defense System (FAADS) force mix analysis studies ongoing at the U.S. Army air Defense Center. The FAADS Force Mix Analysis Model (FFMAM) focuses on the air defense versus aviation battle in the maneuver brigade's forward and rear areas. Particular attention is given to the representation of the FAADS attrition cycle as a Semi-Markov renewal process. Additional emphasis is placed on combat aviation tactics and the impact of terrain on system employment. Model output is presented to demonstrate FFMAM's reaction to selected input changes and to identify attrition related trends.

ANALYSIS OF THE ACCURACY OF A PROPOSED TARGET MOTION ANALYSIS PROCEDURE

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Department of Operations Research

This thesis investigates the accuracy of a recently proposed passive bearings-only Target Motion Analysis (TMA) procedure. The primary method of analysis is to compare computer generated positions of a Target that is moving with a constant course and speed, with the procedurally derived estimated positions. A computer model was developed which simulated several possible interactions between the Target and Own Ship. Estimated parameters of the Target track were computed using the procedure under analysis. These values were compared to the "true" values generated by the simulation. An analysis of the TMA procedure showed that it failed to accurately estimate the target track parameters. However with some modifications, the accuracy improved significantly and it is felt that the procedure can accurately estimate target range (but not necessarily course and speed) for some target geometries.

AN ANALYSIS OF GROUND MANEUVER CONCENTRATION DURING NTC DELIBERATE ATTACK MISSIONS AND ITS INFLUENCE ON MISSION EFFECTIVENESS

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Advisors: LTC B.K. Mansager, USA & R.R. Read
Department of Operations Research

This thesis analyzes deliberate attack missions conducted at the U.S. Army National Training Center (NTC) and checks for relationships between ground force concentration at a battle point of critical attrition and a mission measure of effectiveness (MOE). This analysis should facilitate the development of deliberate attack mission training standards and the monitoring of unit performance in the area of force concentration of massing of combat power. Graphical methods and analytic techniques are developed to describe a point of critical attrition in the battle and various measures of force concentration. The thesis also describes the tank and mechanized infantry task force, the NTC environment and data collection characteristics, accuracy screening techniques for NTC data, and the deliberate attack mission.

AN INTEGER PROGRAMMING APPROACH TO
LONG RANGE SHIPBUILDING SCHEDULING
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This thesis presents an integer programming model to help the Navy develop long-range shipbuilding plans. The model is of a general nature, but is proposed specifically as a decision aid for the developers of the Navy's Extended Planning Annex (EPA). The EPA sets forth planned ship purchases five to 20 years in the future. It is currently produced with a mainly manual process that takes weeks at a time, hence it is extremely difficult for the EPA planners to respond quickly to changes in the given data and assumptions.

The optimization model suggests delivery dates for new ships, based on given budgets and requirements, and accounts for such complexities as the extra costs of building a leadship or of resuming construction after a production break. The model has been formulated with the General Algebraic Modeling System (GAMS) and effectively solved with two commercial optimizing packages. It performs fast enough to allow the planner to make several "what if" runs in the course of developing the EPA.

A BAYESIAN METHOD TO IMPROVE
SAMPLING IN WEAPONS TESTING
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Master of Science in Operations Research - December 1988
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This thesis describes a Bayesian method to determine the number of samples to estimate a proportion or probability with 95% confidence when prior bounds are placed on that proportion. It uses the Uniform [a,b] distribution as the prior, and develops a computer program and tables to find the sample size.

Tables and examples are also given to compare theses results with other approaches to finding sample size. The improvement that can be obtained with this method's fewer samples, and consequently less cost in weapons testing is required to meet a desired confidence size for a proportion or probability.

DEFENSIVE MINEFIELD PLANNING
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Master of Science in Operations Research - June 1989
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This thesis is concerned with the problem of constructing an optimal minefield for inflicting casualties to a Naval Force attempting to penetrate the field. A microcomputer based simulation program dealing with this problem is presented and permits the user to select various mine characteristics (charge weight, depth, sensitivity), number of mines, number of transmitting ships and navigational error.

THE DUAL DECOMPOSITION METHOD AND ITS
APPLICATION TO AN INTERDICTED NETWORK

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This paper introduces the dual decomposition method for determining the distribution of an optimal objective function for a network problem. The objective function is to minimize the shortfall of demands to prioritized sinks for a four day period over a network that is subject to interdiction. The requirements of the model are that the upper and lower bounds of the capacities of the arcs and nodes of the network and the probabilities of interdictions are known. The dual decomposition method is an iterative approach to enumerating the possible instances of the capacities in a capacitated network, based on the dual variables of the previous iteration. The purpose of the procedure is to determine the distribution of the shortfall of demands so that logistics planners can predict the performance of a supply distribution system over a short period of time.

EXPERIMENTAL DESIGN AND ANALYSIS OF M1A1 COMMANDER/GUNNER
PERFORMANCE DURING CONOPS USING THE U-COFT

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This paper presents an experimental design which demonstrates the potential of high fidelity as performance data collection tools. The experiment employs the Unit Conduct of Fire Trainer (U-COFT), an M1A1 Tank simulator to measure the effects of sleep loss on the performance of the commander/gunner team. The Complex Cognitive Assessment Battery (CCAB) will be used to measure sleep loss degradation of cognitive skills. The crews will be subjected to a structured environment for 72 hours with the control crews receiving eight hours of sleep each day, and the experimental crews receiving four hours of sleep each day. Furthermore, half of the experimental groups will sleep during a peak of the circadian cycle and half will sleep during a trough. The results of these experiments will provide commander/gunner team performance distributions for target acquisition, identification, classification, time to fire, accuracy, and system management capabilities during continuous operations (CONOPS). The results of these experiments could be applied to land combat models, like JANUS, as a first step toward incorporating human factors into the models. The capabilities of high fidelity simulators demonstrated by this experiment should cause future simulators to be designed not only for training, but also for data collection and processing.

SURVEY AND ANALYSIS OF SURFACE
WARFARE OFFICER CAREER PATH ISSUES

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Surface Warfare Officers (SWO) attending the Naval Postgraduate School were surveyed on career issues, pertaining career path specialization, warfare skills, SWO qualification, and their impact on readiness. Survey results indicate that: 1) SWO technical competency does not mandate specialization as a means to enhance readiness, 2) assigning department heads to single 30+ month tours work-up and deployment may enhance readiness, implementation of SWO qualification policy may not be supporting adequate qualification standards. Recommendations include: 1) analyses of officer perceptual attitudes and view-points should be part of policy formulation, 2) feasibility and readiness impact studies of alternative department head assignment rotation and tour length policies should be completed, 3) revisions to the methods used to implement SWO qualification requirements should be examined.

AN INVESTIGATION OF THE APAIR ACOUSTIC DETECTION MODEL

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Master of Science in Operations Research - September 1989
Advisor: R.N. Forrest - Department of Operations Research

The subject of this thesis is an investigation of the effect of using the lambda-sigma jump process in the acoustic detection component of APAIR. A computer simulation was developed which is similar to the sonobuoy field versus submarine engagement model found in APAIR, the Navy's general ASW model. This simulation was then modified to incorporate the lambda-sigma jump process and the effect if this modification is discussed. In order to check the structural validity of the simulation models, results that were obtained by using them are compared to results that were obtained by using an analytical model called the random search model.

ENLISTMENT MOTIVATORS FOR HIGH QUALITY RECRUITS IN THE ARMY RESERVE

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G. Thomas - Department of Administrative Sciences

This thesis investigates the relationship between the quality of recruits and the factors that influence their enlistment decision. Demographic variables, such as gender, educational level, marital status, and ethnic group, and quality are related to the propensity to enlist in the Army Reserves. The data was obtained from the 1987 New Recruit Survey of the Army Reserve recruits. The analysis attempts to study what significant differences, if any, there are in the enlistment decision of soldiers who score in the upper 50th percentile of the Armed Forces Qualification Test (AFQT), and those that are in the lower half of the AFWT test results. The results of log-linear factor analysis indicate that educational benefits were important motivation for high quality recruits to enlist in the Army Reserves. Log-linear analysis shows differences among demographic categories in their propensity for enlistment. Factor analysis identifies four underlying factors that influence a recruit's enlistment decision. The four factors were both economic and non-economic and were labelled "Self-Improvement," "Skill Training," Military Service" and Educational Money." The analysis showed significant differences among demographic categories in the importance of these factors in their decision to enlist.

CALIBRATION COEFFICIENT USE AND VALUE SELECTION GUIDANCE FOR THE MOSCOW LAND COMBAT MODEL

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This thesis analyzes the use of calibration coefficient inputs for the Method of Screening Concepts of Operational Warfare (MOSCOW) model. The analysis focuses on how calibration coefficients affect modeled combat processes. Sensitivity analysis is performed to determine the effect of coefficient value changes on selected MOSCOW measures of effectiveness. A detailed description of each coefficient, including recommended input value ranges, is provided. The thesis provides information useful for effective calibration coefficient input value selection.

COMPARISON OF THREE LOGISTIC FORCE MODELS

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This thesis compares the results from three recently developed Combat Logistic Force (CLF) models using a variety of measures of effectiveness. The models used in this analysis were Battle Force Operation Replenishment Model (BFORM), The Replenishment-At-Sea Model (RASM) and the Resupply Sealift Requirements Generator and Ship On-Line Scheduler (RSRG/SOS). The measures of effectiveness (MOEs) used were average time off station, minimum commodity level, final commodity level and number of unreps completed. Several generic scenarios were employed in comparing the models results. Variables evaluated were Speed of Advance (SOA), replenishment mode, force disposition, and level of combat operations. The commodities evaluated were fuel (DFM and JP-5) and missiles (AAM/SAM). Analysis showed that RASM and BFORM results were very similar. However, BFORM results tended to be less optimistic than RASM. RASM and BFORM shared many common strengths and weaknesses. Most notable of the models strengths was the flexibility that the user had in defining the scenario. Significant weaknesses in the models included assumptions of no attrition and unrealistic scheduling of CLF assets. RSRG/SOS did not compare well with the other models because of its aggregated modelling design.

MODELS FOR TARGET DETECTION TIMES

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Some battlefield models have a component in them which models the time it takes for an observer to detect a target. Different observers may have different mean detection times due to various factors such as the type of sensor used, environmental conditions, fatigue of the observer, etc. Two parametric models for the distribution of time to target detection are considered which can incorporate these factors. Maximum likelihood estimation procedures for the parameters are described. Results of simulation experiments to study the small sample behavior of the estimators are presented.

NUMBER OF TEST SAMPLES NEEDED TO OBTAIN A DESIRED BAYESIAN CONFIDENCE INTERVAL FOR A PROPORTION

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One recurring problem in military operational test and evaluation is determination of the number of items to test. This thesis describes a Bayesian method to determine the sample size that is needed to estimate a proportion or probability with a $(1-x)100$ confidence when a prior distribution is given to that proportion. It uses the two variants of the triangular distribution as priors and develops computer programs, graphs, and tables to assist in finding the required sample size. These results are compared with other approaches in determining the required sample sizes that are needed to obtain a desired confidence interval for a proportion or probability.

ANALYSIS OF THE JOINT REORGANIZATION ACT'S IMPACT ON
PERSONNEL FLOW IN THE SURFACE WARFARE OFFICER COMMUNITY
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This thesis introduces a user interactive personnel flow forecasting model, FORECASTER, and demonstrates its use to analyze the effect of the Goldwater-Nichols Department of Defense Reorganization Act on the personnel flow within the Surface Warfare Officer (SWO) community. The emerging problems of filling joint billets with promotable officers while maintaining the support and readiness of the critical fleet units is quantitatively analyzed with FORECASTER and is the focus of this analysis. Two proposed personnel flow scenarios to contend with the DoD reorganization Act are suggested. One establishes a fixed proportion of officers to be sent from at sea billets to joint billets, while the other considers joint education immediately following postgraduate education. The results of these proposals show an increase in joint billet fills while maintaining the fill of critical fleet unit billets.

APPROXIMATE INTERVAL ESTIMATION METHODS FOR
THE RELIABILITY OF SYSTEMS USING COMPONENT
DATA WITH EXPONENTIAL AND WEIBULL DISTRIBUTIONS
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Two approximate parametric interval estimation methods for system reliability using component test data are developed and evaluated. One method can be applied to any coherent system with components which have exponential failure times with possibly different failure rates and different mission operating times. This method estimates the ratios of component failure rates which are then used to develop the approximate lower confidence limit. These ratio estimates are developed with and without jackknife methods and the two results are compared. This procedure is very accurate and simple to compute, requiring the use of standard chi-square tables. This ratio method is subsequently extended to coherent systems with components whose failure times have a Weibull distribution. A nearly exact parametric lower confidence limit for $P(X > x)$ is developed and evaluated where x is given and X has a normal distribution with unknown mean and variance. This procedure is also simple to evaluate and requires the use of Student t tables.

ANALYSIS OF U.S. COAST GUARD
TARGETBOARD REGRESSION MODELS
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To assist with the planning and efficient use of Coast Guard resources in this county's war against drugs, the Coast Guard Intelligence Coordination Center utilizes a project called Targetboard. Targetboard uses regression models to predict future levels of potential drug trafficking contacts from a Coast Guard developed data base. This thesis attempts to update this process by defining and cross-validating new regression models. Various regression analysis methods are used, including a system of simultaneous linear equations. Statistically significant ordinary least squares regression models are defined with the stepwise selection procedure. However, the regression models fail cross validation tests and do not predict new values consistently. Consistent and accurate predictions are necessary if the models are to be an effective weapon against drug traffickers.

A MODEL FOR OPTIMIZING FIELD ARTILLERY FIRE

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A microcomputer based optimization model for short-term allocation of field artillery fire is developed and evaluated. The Artillery Optimization Models utilizes a mixed integer linear program that takes available targets, weights the targets by performing Target Value Analysis, and assigns firing units specific amounts and types of ammunition to fire at designated targets. In determining the optimal near-term allocation of artillery resources, the model considers the target's intrinsic value, current ammunition levels, future ammunition resupply, capabilities and limitations of the firing units, the ability to mass fires, and the commander's criteria for target destruction. The model has been evaluated via direct competition with three experienced artillery officers using the Janus(T) high resolution combat simulations. The results of the evaluation have shown that the Artillery Optimization Model produces a greater destruction, per projectile, than any of the artillery officers. If the results of the evaluation are projected over the course of a battle, the combat power of the field artillery would be substantially increased using the Artillery Optimization Model.

ANALYSIS OF RESUPPLY OPTIONS FOR AN ARMOR BATTALION

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Forward area resupply of combat maneuver units is analyzed in this thesis by using the JANUS (TRASANA) (T) high resolution combat model. The goal of this thesis is to analyze two different resupply vehicles and various doctrinal concepts for the deployment of these vehicles. Combat between a United States Army battalion take force and two Soviet tank regiments generates a need for the U.S. force to resupply. Using various doctrines, the resupply vehicles will attempt to provide logistic support to the U.S. forces.

MARINE CORPS JOINT ASSIGNMENT MODEL UNDER TITLE IV OF THE GOLDWATER-NICHOLS ACT OF 1986

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This thesis reviews the requirements imposed on Marine Corps manpower managers by Title IV of the Goldwater-Nichols Department of Defense Reorganization Act of 1986. An interactive computer program, TITLE IV, is introduced as a tool which manpower managers can use to forecast the effect of manpower decisions in regards to compliance with Title IV regulations. The model uses a "push-pull" process which pushes officers with joint duty experience through their Marine Corps career and pulls officers into joint duty billets. Several billet strategies were developed to demonstrate the models flexibility and potential use to manpower managers.

EXTENSION OF AGGREGATION AND SHRINKAGE TECHNIQUES USED IN THE ESTIMATION OF MARINE CORPS OFFICER ATTRITION RATES

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In this thesis, we treat the "small cell" problems encountered when building an attrition rate generator for largescale manpower flow models, specifically for the USMC Officer Corps. Such models have a large number of low-inventory (i.e. small) personnel cells. This presents a dilemma: on one hand we want to preserve as much fidelity as possible in our work by preserving a great deal of detail in each cell; on the other hand, our statistical estimation techniques require larger cell sample sizes than intrinsically occur cell-by-cell in actual sample data. Our approach to producing stable attrition rates for such cells involves two efforts: (i) the aggregation of cells into groups that exhibit homogeneity of attrition behavior, and (ii) the development of "shrinkage" estimation techniques for use in the individual groups. A heuristic algorithm is developed and tested to treat the aggregation problem. Empirical Bayes methods are developed to serve the multi-cell estimation requirements needed to preserve the fidelity. Cross validation techniques are used to verify these methods. The present work builds upon the results of previous studies, we integrate what was learned into a coherent package that is ready for use.

A SIMULATION STUDY OF AN OPTIMIZATION MODEL FOR SURFACE NUCLEAR ACCESSION PLANNING

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Master of Science in Operations Research - September 1989
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This thesis examines a nontraditional approach to a manpower planning problem. This approach combines two operations research methodologies: simulation and optimization. The combined approach, which is referred to as SIMOP, models the manpower planning problem as a linear program and, through simulation techniques, allows the input data to be random. Based on the experimentation performed in this study, the average results from the SIMOP model can be quite different from the result obtained using a traditional optimization model. Also presented are applications of the SIMOP model to military manpower planning.

A DECISION AID MODEL FOR A MANEUVER FORCE COMMANDER THAT INCORPORATES THE QUANTIFIED JUDGMENT MODEL

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Master of Science in Operations Research - March 1989
Advisors: LTC B.K. Mansager & LCDR T.M. Mitchell
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The commander on the modern battlefield has the responsibility of supervising more assets and evaluating more information than ever before. Therefore, there exists a need for an aid to assist the commander in selecting a recommended course of action. The purpose of this thesis was to develop a tactical decision aid model that would assist the commander in selecting a course of action. The Quantified Judgment Model (QJM) served as the algorithm in this decision aid model. The QJM is a combat model that analyzes ground combat with a primary focus on the historical aid model included: 1) initial force structure for a US and Soviet force, 2) non tactical variables that influence the battle, 3) intelligence, 4) operational and environmental factors, and 5) current doctrine. The model varied the input variables and determined a force structure necessary for the battle to end in a draw. The primary focus of this thesis was not the assumptions made in the model or the tactical situation examined, but the methodology used in developing the model.

EVALUATION OF MODIFIED AMSAA CONTINUOUS RELIABILITY GROWTH MODEL USING FAILURE DISCOUNTING AND WEIGHTING FACTORS

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Failure discounting is the practice of removing fractions of failures from test data after corrective actions have been taken and no failures due to the same cause have reoccurred. This thesis examines the affect of discounting failures and weighting test data on the accuracy of an existing reliability growth model, labeled the Modified AMSAA model. Computer simulation is used to evaluate the mean and mean square error of failure rate estimates under the model for a variety of reliability growth patterns each with several discounting and weighting scenarios. Exponential failure times are assumed and testing is truncated at two failures in each test phase. Failure discounting tended to decrease the mean square error slightly for growth patterns with a continual drop in failure rate for each new test phase, but tended to increase the mean square error for other patterns. The Modified AMSAA model is also shown to be superior to the standard AMSAA reliability growth model in bias and mean square error. No discernable benefits due to weighting the data were detected.

ISOLATION OF IMPORTANT INPUT FACTORS IN THE PERFORMANCE OF OPERATIONAL PROPULSION PLANT EXAMS (OPPE) AND LIGHT OFF EXAMS (LOE) FOR ATLANTIC FLEET SHIPS

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This thesis examines the relationship between independent variables such as underway time, material condition, and personnel manning and dependent variables in the form of engineering exam scores. Multinomial linear regression models are used to examine these relationships. These efforts met with limited success. The percent of time that a ship spends underway prior to an OPPE was the most significant of any independent variable considered, yet efforts to model the effect of diminishing returns were unsuccessful. Outcrop OPPEs failed to show any significant relationship for the underway independent variable examined, but they did reveal that ships which file a greater number of CASREPs prior to receiving an outcrop OPPE increase their odds of receiving a favorable test score. Attempts to model LOE were unsuccessful.

IMPROVING INTELLIGENCE, TARGETING, AND FIRE SUPPORT ALLOCATION FUNCTIONS IN THE FORCE EVALUATION MODEL (FORCEM)

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The Force Evaluation Model (FORCEM) is a low resolution, deterministic, time stepped combat simulation designed for the evaluation of force structures in a theater of operations The fire support allocation module in FORCEM allocates battalions and type and quantity of ammunition to engage enemy targets based on input from experienced personnel. All enemy targets within an arbitrarily determined range of the corps or higher headquarters are considered for fire support engagement. In this thesis we propose a realistic method for determining field artillery targets to be considered eligible for engagement. We also formulate a linear programming problem to optimally allocate battalions and type and quantity of ammunition to the eligible targets. The results form the LP model compare favorably with those provided by FORCEM'S fire support allocation module.

OPTIMIZATION MODELS FOR MILITARY AIRCRAFT DEPLOYMENT

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A military aircraft deployment problem from the United States Transportation Command is modeled as a generalized transportation problem package. The model involves the assignment of military units and material to aircraft and the assignment of aircraft to missions in order to appraise the utility and to determine the assets required for preliminary military operation plans. A transformation of this model which aggregates variables relating to the early or late delivery of requirements is also described. A specialized algorithm which separates an instance of the model into sub-groups of independent time windows, finding the globally optimal solution by solving independent subproblems is also explored. Lastly, an integer rounding model is described which converts continuous solutions to integer in order to facilitate implementation of the former models with an existing post-solution processor. Excellent quality solutions are provided for problems involving nine routes, 80 movement requirements distributed across two cargo classes involving 200,000 short tons of freight, and 250 aircraft using four different aircraft type for each of 12 time periods. The problem, which has the potential of having over 10,000 variables, is reduced significantly using variable reduction and the aggregation transformation. The reduced problem requires approximately 1,000 variables and 300 constraints and solutions are obtainable in user 14 minutes using the General Algebraic Modeling System on an 80286-based personal computer.

EVALUATION OF HEAD-UP DISPLAY FORMATS FOR THE F/A-18 HORNET

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This study evaluates symbols and formats for the F/A-18 Hornet head-up display (HUD) and Attitude Directional Indicator (ADI) for use by pilots in recovering form unusual aircraft attitudes. Two surveys were conducted to collect pilot opinions on various symbols and formats, based on past experimental research and current recommendations. For the first survey, 60 F/A pilots prioritized several types of HUD symbols according to the amount of information these symbols provide for the pilot while he is in an unusual attitude. In some cases, the pilots also were asked to choose their preferred symbols. The second survey was based on the results of the first and was administered to 56 F/A 18 pilots. These pilots selected their preferred HUD or ADI display formats, choosing one form two to five possibilities in each case. The specific symbols and formats that were evaluated are described in detail. Survey results are provided, and recommendations are made for display implementation and for further research and testing of symbols and formats.

A COMPUTATIONAL COMPARISON OF THE PRIMAL SIMPLEX AND RELAXATION ALGORITHMS FOR SOLVING MINIMUM COST FLOW NETWORKS

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This thesis examines the relative computational efficiencies of two advanced network minimum cost flow problem solution methodologies: the primal simplex specialization to networks developed by Bradley, Brown, and Graves (1977)--GNET and XNET, and a Lagrangian relaxation method developed by Bertsekas and Tseng (1988)--RELAX-II and RELAXT-II. Also, the relaxation methods description is clarified and potential implementation improvements are investigated. Research by Bertsekas and Tseng has shown the relaxation codes to be on the order of four to five times faster than the primal simplex codes. This thesis fails to duplicate those results. While the relaxation codes do perform faster in many circumstances when solving purely random problems, the primal simplex codes are still closely competitive. In particular, the primal simplex codes appear more efficient at solving capacitated transshipment problems in networks with an echelon structure and in networks with many more sinks than sources. Primal simplex codes also require about half the computer storage space of the relaxation codes. The research has produced compelling evidence that the relaxation algorithms can be further refined. All indications appear to reinforce the desirability of prioritizing by absolute deficit the node selection process used in both relaxation codes. Further research is recommended.

SAMPLE SIZE FOR CORRELATION ESTIMATES

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This thesis examines the classical measure of correlation (Spearman's r and Kendall's t) with the goal of determining the number of samples needed to estimate a correlation coefficient with a 95% confidence level. For Pearson's R, tables, graphs, and computer programs are developed to find the sample number needed for a desired confidence interval size. Non-parametric measures of correlation (Spearman's r and Kendall's t) are also examined for appropriate sample numbers when a specific confidence interval size is desired.

HUMAN FACTORS EVALUATION OF COLOR USE IN THE TARGET DATA PROCESSOR RELEASE 10 (TDP R10)

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This thesis provides color use guidelines for static military CRT display formats. A total of 13 guidelines are discussed, relating to 1) color as a coding dimension, 2) the quantity of colors to include, 3) selection of colors to use, 4) ambient luminance, 5) display legibility and readability, 6) human color deficiencies, and 7) operator fatigue. Guidelines are then applied to the operators-machine interface of the U.S. Navy's Target Data Processor Release 10 (TDP R10), a tactical computer workstation for use in the Integrated Undersea Surveillance System. Specific color related design recommendations are included for the TDP R10 alpha-numeric and geographic display screens with the goal of enhancing user performance. Since the TDP R10 is being developed using an interactive design process (design, test, redesign, etc.), test and evaluation considerations are also discussed at length. Various types of user self-report techniques are discussed, along with user performance testing, sample sizes, and data analysis procedures.

A PSYCHOMETRIC METHOD FOR DETERMINING OPTIMUM, TACTICAL
PATHS IN COMBAT DECISION MAKING AND ANALYSIS

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Thi, thesis examines and demonstrates for determining optimum, tactical movement paths for a specified vehicle and/or small unit based on the operator's cognitive decision process, as well as the physical effects of terrain and environment on mobility. The approach specifically used psychometric techniques inherent to the Generalized Value System (GVS) in order to determine a "Power Function" based on the specific tactical scenario and given equipment configuration which provides a means to determine the Tactical Movement Potential (TMP) for each terrain cell. This cognitive value in an interval scale can then be translated into the same scale as the physical continuum using techniques proposed by L.L. Thurstone and W.S. Torgerson. The cognitive time value based on the user's decision process is then added to the physical traversal times for each cell computed from output provided by the Condensed Army Mobility Management System (CAMMS). This renders a value mapping which can be optimized using one of several existing algorithms. The Dijkstra Algorithm is used in this demonstration model. The resulting sets of path points are optimized for speed/time and the cognitive tactical considerations evaluated using these psychometric methods thereby rendering a truly optimum, tactical movement path and optimum traversal time. The movement path and resulting times can be used in combat planning and modelling. This output is also particularly important in determining the time values needed to compute the Situational Inherent Power (SIP) of the GVS. In actuality, this methodology could be applied to almost any tactical decision process in the development of expert systems and models.

DYNAMIC SYSTEM RENEWAL PLANNING MODEL

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This thesis proposes a framework by which optimal system renewal decisions may be made in a consistent and timely manner within the military, under realistic conditions of changing environments. A unique network representations of the system renewal process was used to develop a prototype version of the analytical core model. Its plausibility and usefulness was demonstrated by a series of case studies. The case studies also show how pertinent staff forecasts can be organized and integrated to provide decision makers with a broad, consistent, long-term perspective of the issues relevant to system renewal planning. They are presented with a graphic pictures of the entire solution space as structured by the scenarios considered. Various solutions are suggested for each scenario and their robustness may be tested by thoroughly exercising the model for a wide range of scenarios. Prediction of what and when renewals are likely to be and estimation of the associated cost of effectiveness allow anticipatory long term plans to be formulated. The thesis also suggests how bulk versus phased procurement decisions and force level and mix issues could be analyzed using the model.

A HETEROGENEOUS TIME-STEP ATTRITION ALTERNATIVE FOR THE MOSCOW LOW RESOLUTION COMBAT MODEL

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The method of Screening Operational Concepts of Warfare Model (MOSCOW) is a low resolution analytic tool designed by the RAND corporation to assist decision-makers in comparing the performance of alternative warfighting doctrines. Recent analysis of this method suggest its current battle attrition mechanism places unreasonable conceptual limits ont he model's usefulness. This thesis considers an alternative way to compute battle attrition which does not suffer from these difficulties.

THE ESTIMATION OF UNITED STATES ARMY REENLISTMENT RATES

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The U.S. Army uses cash selective reenlistment bonuses (SRB) to encourage soldiers in selected military occupation specialities (MOS) to reenlist. Estimates of the reenlistment rate as a function of bonus level are needed for each MOS as input to a bonus allocation model. This thesis outlines and uses a new method for predicting the reenlistment rates as a function of bonus level. The approach involves partitioning the soldier population into cells with stable reenlistment rates using demographic variables. The cells are aggregated using clustering techniques to produce groups of cells which exhibit homogeneity of reenlistment behavior. Regression models are developed for each group of cells. MOS reenlistment rates are determined as a linear combination across cells. Cross-validation techniques are used to lend credibility to the predictive model. The study points out the usefulness of identifying categories of soldiers who display unique reenlistment behavior.

OPTIMAL SHIP BERTHING PLANS

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A ship berthing plan assigns surface vessels a berth prior to their port entrance, or reassign ships once in port to allow them to accomplish in a timely manner maintenance, training, and certification event which build readiness for future operational commitments. Each ship requires different services when in port, such as shore power, crane services, ordnance, and fuel. Unfortunately, not all services are offered at all piers. At present, ship berthing plans are manually prepared by a port operations scheduler and often result in unnecessary berth shifts, which puts ships out of action for several hours. An extensive user friendly computerized optimization model is developed and tested to assist the schedulers in the creation of a berthing plan which minimizes port loading conflicts, thus promoting fleet readiness through berthing stability. Norfolk Naval Station is used as an example because it exhibits all the richness of berthing problems the Navy faces.

A SIMULATION OF SHIP SURVIVABILITY VERSUS
RADAR DETECTION AGAINST LOW FLYING TARGETS

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A simulation is developed (System Performance Simulation, or SPS) which models ship survivability under Surface-to-surface missiles' (SSM) saturation attack. Using this simulation, a plan of improving the weapon systems is developed for current Naval ships.

The plan is used in a deterministic model which predicts the results of the inner air battle, and is responsive to the attack and defense characteristics and variables.

DEVELOPMENT OF A METHODOLOGY TO OPTIMALLY
ALLOCATE VISUAL INSPECTION TIME

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Many production facilities rely on the intuition of the quality assurance inspector for determining what will be visually inspected and for what length of time on a finished product. In this thesis, a model for visual inspection is developed. The key parameters in the model are the probability of worker error, the probability of inspector error, and the coast of system error. Paired comparison of error phenomena form operational personnel are converted to probabilities using the indirect numerical estimation technique. The model is used in a goal program to optimize the use of inspector time in a production facility. The model and the goal program are applied to a military problem to demonstrate the broad applicability of the methodology. The military problem is the allocation of inspection time before firing an artillery weapon to insure accurate and timely delivery of projectiles.

A NONLINEAR PROGRAMMING MODEL FOR OPTIMIZED SORTIE ALLOCATION

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The United States Air Force uses a nonlinear programming model to assess the utilization of weapons and sorties needed to achieve a maximum value of destroyed targets in a multi-period, Theater-level conflict. The current model is modified by constraining the consumption of weapons. Alternate objective functions are introduced. The meaning and influence on the optimization is compared. An increase in the worth of destroyed targets is gained if the model can more flexibly utilize weapons than is currently the case. The optimization can be further improved if all time periods are considered simultaneously while assigning sorties to targets, rather than the current myopic approach.

MASTER OF SCIENCE
IN
PHYSICS

COMPARISON OF EMP AND HERO PROGRAMS

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Because of the unique features of electromagnetic pulse (EMP) and Hazardous Electromagnetic Effects on Ordnance (HERO), much research and money has gone into protecting weapon systems and ordnance against it. The EMP and HERO phenomena do have a variety of differences and require differences of hardening technique to protect against it. However, they both involve radiation effects and can prematurely initiate ordnance via the electroexplosive device (EED). Protection of weapon systems and ordnance against electronic damage and upset plus EED initiation takes on more of an art form rather than science once basic principles are applied. Nevertheless by relating these two programs via the initiating temperature of the EED, they can be accurately compared with each other. Because of this observation, the two programs can be effectively combined to work jointly on ordnance hardening and protection including all forms of radiation type hazard, present and future.

AN INVESTIGATION INTO BACKSCATTERED CROSS SECTION CALIBRATION OF AN ACOUSTIC SOUNDER USED FOR ANALYSIS OF LOWER ATMOSPHERIC TURBULENCE

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Atmospheric temperature structure fluctuation quantified by CT2 degrade the spatial and temporal coherence of electromagnetic and acoustic waves propagating in the atmosphere. A computer controlled atmospheric echosounder developed at the Naval Postgraduate School measures a time averaged CT2 profile of the lower atmosphere. Assigning the proper CT2 values to the backscattered return signals depends on an accurate calibration of the instrument. Calibration involves determination of the product of the echosounder's transmission efficiency Et and reception efficiency Er. This thesis provides a preliminary investigation of a calibration process using pulsed acoustic energy backscattered from hard spheres. Supporting software calculates the desired product ErEt based on an assumption of echosounder efficiency reciprocity. Results of the calibration process investigation indicate this assumption may be invalid. The results also indicate the software performs as intended and that the proposed calibration method possesses sufficient merit to warrant further development.

AN INVESTIGATION OF THE PRODUCTION OF NITRIC OXIDE BY SOFT SOLAR X-RAYS IN THE E-REGION OF THE IONOSPHERE

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The production of nitric oxide by soft solar X-rays in the E-region of the ionosphere is investigated. An empirical expression for the variation in X-ray flux as a function of F10.7 is determined. This expression is incorporated into a one dimensional diffusive photochemical model to compute nitric oxide densities. The results of these calculations are compared with nitric oxide observation from the Solar Mesosphere Explorer satellite. Variations of X-ray flux by a factor of 30 over the solar cycle can explain the observed variation in nitric oxide densities.

A PC-BASED IMAGING SYSTEM FOR THE NAVAL POSTGRADUATE SCHOOL INFRARED SEARCH AND TARGET DESIGNATION (NPS-IRSTD) SYSTEM

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A system to display images from data generated by the Naval Postgraduate School Infrared Search and Target Designation (NPS-IRSTD) system (modified AN/SAR-8 ADM) was developed using and Intel 80386 CPU based desktop computer as the base platform. This computer was enhanced with a Metrabyte PDMA-16 Input/Output board to facilitate data transfer and a Data Translation DT2861 frame-grabber board for image processing. Images are display on a 512 by 480 pixel resolution color monitor. Digitized NPS-IRSTD data is stored on recording tape, and accessed for imaging during playback at reduced speeds. Data is received into the 386 computer through the PDMA-16 using Direct Memory Access (DMA) transfer into Random Access Memory (RAM). Data is sorted in RAM into the proper format for display, and then moved to a frame buffer in the DT2861. FORTRAN programs using Data Translation DT-IRIS subroutines were written to manage display and processing. Images produced using the system showed clearly identifiable features from the scene observed by the IRSTD. They also provided valuable insight into the IRSTD operation. For example, the detector AC-coupling undershoot was clearly evident. Additionally, images showed the number of nonoperational detectors to be larger than previously noted. Recommendations are made for system improvement to enhance speed and reliability, and study of the imaging properties of the NPS-IRSTD.

DEVELOPMENT OF A SYSTEM MODEL AND LEAST MEAN SQUARE (LMS) FILTER FOR THE NAVAL POSTGRADUATE SCHOOL (NPS) INFRARED SEARCH AND TARGET DESIGNATION (IRSTD) SYSTEM

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A system model and a least mean square (LMS) filter for the Naval Postgraduate School (NPS) Infrared Search and Target Designation (IRSTD) system was developed. The system model was developed and run on the NPS IBM 3033/4381 mainframe computer network. The model simulated the effects of the optics and electronic processing equipment of the IRSTD system, and produced output data representative of the detector outputs of the system. The outputs of the IRSTD model were used to develop a digital filter based on the principle of least mean square optimization between an actual IRSTD detector output and a power series expansion represent a detector output containing both background clutter and a model target signal. It was determined that the raised cosine function served as the best model for IRSTD point and near-point targets, 0.1 mrad by 0.1 mrad to 1.5 mrad by 1.5 mrad and a set of trial LMS filters were generated based on this model. After filtering both simulated and real data, consisting of simulated and real target signals embedded in simulated and real backgrounds, it was determined that an LMS filter generated from a raised cosine with a half-amplitude width of 0.9 mrad was optimal for point and near point targets. The signal-to-noise ratios of all target and back-ground combinations increased by a factor of approximately 30 for the simulated backgrounds, and approximately six for the real backgrounds, upon filtering the detector outputs with the optimal LMS filter. It is believed that this filter should be incorporated in the NPS IRSTD system as an initial signal processing filter, and that the filtered outputs are appropriate for use as inputs to target detection and acquisition routines.

TARGET VOLTAGE RESPONSE IN REACTION TO LASTER RADIATION

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A five microsecond, 15 joule, pulsed $CO2$ Laser was used to irradiate polished 2024 aluminum targets. The target voltage response (TVR) was measured with respect to the incident laser radiation and showed a pulse width on the order of 30 nanoseconds. The voltage was measured at values from 22 to 140 volts with resistances varying from one ohm to two mega-ohms. The TVR was correlated to the emission and blow-off of electrons from the target surface and the possible ignition of Laser Supported Detonation wave. The TVR, laser pulse, and flash associated with target surface breakdown were time correlated and shown to happen within the first 170 nanoseconds of the five microsecond laser pulse. Currents up to 500 amps were observed when the resistance to ground was reduced to less than 1 ohm. Also, the magnitude of the TVR was shown to be a function of background gas pressure.

THREE-DIMENSIONAL ANALYSIS OF OPTICAL TRANSITION RADIATION

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A three-dimensional analysis of the intensity of distribution of backward optical transition radiation has been performed. The effects of variations in electron energy and beam divergence and on material properties such as dielectric permittivites and the resultant coherence length upon the angular distribution and polarization of optical transition radiation has been investigated. A surprising observation important to the use of optical transition radiation as a diagnostic tool for high energy electron beams is the behavior of the perpendicular component of the intensity. In contrast to low energies where the parallel component dominates at electron energies above 200 MeV, the perpendicular component dominates. This requires the use of a polarization filter to diagnose particle beam properties at high energies.

ATOMIC RELAXATION AND VACANCY-INTERSTITIAL RECOMBINATION IN ZR AND ZR3AL

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This thesis examines two problems associated with crystal line defects in the materials Zr and Zr3Al, by means of a molecular dynamics computer simulation. In the first problem, the relaxed configuration around a single vacancy, a di-vacancy and tri-vacancy is computed by introducing the defect into a perfect lattice and dynamically relaxing the crystal until it attains equilibrium. The results are in qualitative agreement with "static" studies but show clearly that first and second neighbors have different relaxed states depending on their configuration in the initial crystal lattice. The recombination studies show that a vacancy interstitial pair quickly relaxes to the perfect crystal if the interstitial is within an adjacent crystalline cell.

DEVELOPMENT OF A DIFFERENTIAL TEMPERATURE PROBE FOR THE MEASUREMENT OF ATMOSPHERIC TURBULENCE AT ALL LEVELS

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Fluctuating temperature structures in the atmosphere induce phase perturbations in a propagating laser beam. These turbulent conditions occur throughout the atmosphere and cause the laser beam to spread and alter its centroid. There are several methods to measure the parameters of optical turbulence in the atmosphere, but a few that will determine them as a function of altitude profiles of turbulence as with a temperature probe launched via a balloon system. This thesis involves the development of a differential temperature probe sensor to measure the temperature fluctuations at all altitudes in the atmosphere. In addition, it investigates the effect of solar heating on the probes in the atmosphere and the subsequent effects on the measurements. A validation of the probe system was made by a comparison test with an acoustic echosounder developed earlier. In addition to validating the probe system, the absolute CT2 analysis of the echosounder was confirmed.

OPERATION AND CHARACTERISTICS OF THE FLASH X-RAY GENERATOR AT THE NAVAL POSTGRADUATE SCHOOL

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Installation of the Model 112A Pulserad Pulsed X-Ray Generator at the Naval Postgraduate School Flash X-Ray Facility was completed in August of 1988. Characterization of the Pulserad 112A is essential to its effective use in future radiation effects study. This study will describe the basic system components, the principles of beam generation, and the characteristics of the radiation output. Fundamentals of radiation dosimetry and application to flash X-ray sources will be discussed. Finally, the results of initial mapping of the radiation field generated by the Model 112A Pulserad Pulsed X-Ray Generator will be presented.

DYNAMIC RECONFIGURATION AND LINK FAULT TOLERANCE IN A TRANSPUTER NETWORK

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This thesis explores dynamic reconfiguration and link fault tolerance in a Transputer network using software controlled cross-bars. A message exchange system was designed, implemented and evaluated to facilitate testing various aspects of dynamic interconnectivity between processing nodes as well as detection and recovery from failed network links without loss of data. As implemented, the message exchange can be embedded with application code which can direct network topology to facilitate code execution.

MEASUREMENTS OF BUBBLE PROPERTIES
USING MULTI-FREQUENCY SOUND FIELD

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An apparatus was designed, constructed, and tested to measure properties of single bubbles in a fluid by use of a multi-frequency sounds field. The theoretical background on the dual frequency method for obtaining bubble properties such as resonance frequency, rectified diffusion threshold and rates, rise-time sizing, and damping coefficients are discussed. Specifications and design of the device are presented. Sizes of single air bubbles in water determined from dual frequency methods are compared to rise-time sizing for radii from 30 to 115 um, these two methods are shown to agrees within 1%. Rectified diffusion rates measured above at and below threshold for an initial bubble radius of 50 um in air saturated water over a period of 700 seconds were measured and the results demonstrate the reliability of the system. The potential of this device to measure damping coefficients is discussed.

COMPUTER SIMULATION OF COPPER IN THE LIQUID PHASE AND THE
SPUTTERING OF LIQUID COPPER BY ONE KEV ARGON IONS

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A molecular dynamics computer simulation was used to investigate several techniques of generating liquid Cu targets. The target with the best liquid characteristics was subject to one KeV, argon ion bombardment as a preliminary study of the sputtering of liquids. The techniques of warming by impulse and warming by initially displacing atoms from their equilibrium positions were compared. Both methods produced targets with good liquid properties. The energy became equally partitioned between kinetic and potential energy and all targets equilibration was found to be restricted to its initial neighborhood. The preliminary sputtering study resulted in a sputtering yield increase of 40% over the solid target, for a low index crystal plane.

THE MOVING PLATFORM SIMULATOR II: A NETWORKED REAL-TIME VISUAL
SIMULATOR WITH DISTRIBUTED PROCESSING AND LINE-OF-SIGHT DISPLAYS

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Previous research has produced a realtime Moving Platform Simulator using Defense Mapping Agency digital terrain elevation data and a Silicon Graphics, Inc. IRIS 4D/70GT graphics workstation. This study is a continuation of that effort with the multiple goals of investigating the effects on simulator performance of using higher resolution terrain and different terrain drawing algorithms. Also investigated was the integration of realtime, actual platform data, electronically gathered by position-location reporting instruments and platform intervisibility determinations into the simulator. Included in this effort was a study of modeling time and a real world coordinate system. Additional work was performed on using a distributed computing architecture to maximize simulator performance.

A SIMULATION OF OPTICAL PROPAGATION THROUGH ATMOSPHERIC TURBULENCE USING TWO-DIMENSIONAL FOURIER TRANSFORM TECHNIQUES

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Understanding turbulence degradation of electromagnetic wave propagation is essential for efficient operation of laser weapons, target designators, and imaging systems. Random atmospheric refractive index inhomogeneities alter the phase and amplitude and electromagnetic waves. This thesis attempts to model atmospheric turbulence effects by using filtered Gaussian phase screens to represent the random nature of refractive index changes. The simulation uses two-dimensional 512x512 fast Fourier transform (FFT) techniques with extended Huygens-Gresnel principles performed on a desk top computer. Simulation verification was accomplished by comparing calculated and theoretical spatial coherence lengths, po. Phase only screens produced coherence lengths that were 30% larger than theoretical values. By using random phase and amplitude screens, the calculated coherence lengths agreed to within 3% of theoretical values. Saturation of the normalized intensity variance, $o2/I2$, occurred for increasing turbulence using a single phase-amplitude screen.

NUMERICAL SIMULATION OF OPTICAL TURBULENCE UTILIZING TWO-DIMENSIONAL GAUSSIAN PHASE SCREENS

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Propagation of electromagnetic energy through the atmospheric is a difficult task because of temperature fluctuations and index-of-refraction inhomogeneities which degrade the beam's coherence. Understanding this phenomena is a practical importance for optical systems. This thesis presents an analytical/numerical technique which simulates the effects of atmospheric turbulence. The extended Huygens-Fresnel principle was used to simulate wave propagation in a two-dimensional randomly varying medium, which is represented by thin, filtered, Gaussian phase screens. The wave optics code implements both Fresnel and Fraunhofer propagation, by employing the fast Fourier transform (FFT) algorithms. The analytical spatial coherence length, po, and normalized intensity variance, $o2/I2$, of the perturbed electric field, were examined. Results support the concept of intensity saturation for weak scattering cases, however, differences in the values of the theoretical and analytical spatial coherence lengths occurred.

RADIATION SIGNATURES FROM AN EXTERNAL RELATIVISTIC ELECTRON BEAM

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We have observed x-band radiation which occurs when an electron beam travelling in air traverses an aluminum plate. The radiation pattern is more complicated than can be explained with a simplified model of Cerenkov radiation from air and transition radiation from the aluminum-air interface. The empirical observation is that the peak angle decreases with energy until about 70 MeV., then increases with energy. The angular width of the peak distribution shows a similar behavior with energy. The observed peak angle decreases as the distance from the horn antenna to the aluminum foil is increased. The explanation of the distribution observed is not yet satisfactory. A major improvement in the data accumulation process has been introduced by measuring radiation at a fixed angle as data is taken with a movable horn. This procedure allows us to compensate for the fluctuating electron beam intensity. The data can now be digitized and stored in a computer for analysis. Previous experiments allowed only for analog measurements. Further work, both theoretical and experimental, will be required to understand fully the radiation signature of the electron beam.

DEFINITION STUDY AND MODEL FOR A TETHERED SOUNDING ROCKET

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The HOCAT experiment is a sounding rocket payload to measure the coupling of large currents (up to 1 A) from a satellite into the ambient plasma, and the return path through the plasma. The devices to be used to establish electrical contact with the plasma are hollow cathode plasma sources, using xenon propellent. Two satellite sections will be connected by a 100-m cable, which can be used to bias the two satellites with respect to each other. The current through the connecting cable will be monitored, along with the particle fluxes to the satellites. A fiber-optic technique will be used to measure the return current flowing through the ambient plasma. Electric fields, densities, and plasma waves will be monitored with floating probes. We intend to launch this payload from Wallops Flight Facility two years after funding begins.

MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING
(ELECTRONIC WARFARE)

MOBILE TACTICAL HF/VHF EW SYSTEM FOR GROUND FORCES

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This thesis specifies a mobile tactical C3CM system covering the HF/VHF frequencies for use by ground forces. The description and analysis of a system that can intercept, analyze, DF, monitor and if necessary, jam the frequency bands of interest is presented. The system analysis and possibilities of ESM/ECM are considered in order to construct the overall theory of countering enemy communications from a tactical point of view. General system requirements, i.e., tactical, environmental, and human factors are also discussed. A concept of a mobile tactical HF/VHF system is described from performances and functional points of view. Finally, a desired specification outline maximizing use of "off the shelf" available components is presented. A summary and future projections, are also provided.

OPTIMIZING ECM TECHNIQUES AGAINST MONOPULSE ACQUISITION AND TRACKING RADARS

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ECM techniques against monopulse radars, which are generally employed in the Surface to Air Missile targeting system, are presented and analyzed. particularly, these ECM techniques classified into five different categories, which are; denial jamming, deception jamming, passive countermeasures, decoys, and destructive countermeasures. The techniques are fully discussed. It was found difficult to quantize the jamming effectiveness of individual techniques, because ECM techniques are involved with several complex parameters and they are usually entangled together. Therefore, the methodological approach for optimizing ECM techniques is based on purely conceptual analysis of the techniques.

A SIMULATION OF A COMBINED ACTIVE AND ELECTRONIC WARFARE SYSTEM FOR THE DEFENSE OF A NAVAL SHIP AGAINST MULTIPLE LOW-ALTITUDE MISSILE THREAT

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A computer simulation model was developed (Interactive Simulation of System Performance, or ISSP) simulating the integrated performance of hard kill (surface to air missile, or SAM and close in weapon system, or (CIWS) and soft kill (defensive jammer, or ECM, and Chaff) systems in the defense of a single Naval ship against attack threat by four anti ship missiles (ASM). The quantitative contribution of each system to ship survivability is evaluated. The hard kill and soft kill weapon systems are the focus of the two major anti warfare (AAW) improvement plans assessed in this simulation. Based on these plans, six decision options were created. In addition, this study provides an analysis and comparison of the results of the inner air battle abstracted from various weapon models. Finally, the use of the simulation results in making choices among candidate weapon system is illustrated.

OPTICAL EXCISOR MODELING

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This work simulates an acousto optic signal processing technique that can be used to filter radio frequency (RF) electronic signals. Of particular interest is the removal or excision of narrowband interference from broadband signals. The program developed simulates the performance of a binary phase shift keying (BPSK) signal with a narrowband interference. The width and depth of notches that model an excisor detector array are variable. In addition, there is a capability to move the notches in order to place a notch over the interference for a maximum filtering capability. A summary of several possible excisor techniques is presented.

COMPUTER AIDED MATHEMATICAL ANALYSIS OF PROBABILITY OF INTERCEPT FOR GROUND BASED COMMUNICATION INTERCEPT SYSTEM

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We develop a mathematical analysis model to calculate the probability of intercept (POI) for the ground based communication intercept (COMINT) system. The POI is a measure of the effectiveness of the intercept system. We define the POI as the product of the probability of detection and the probability of coincidence. The probability of detection is a measure of the receiver's capability to detect a signal in the presence of noise. The probability of coincidence is the probability that an intercept system is available, actively listening in the proper frequency band, in the right direction and at the same time that the signal is received. We investi- gate the behavior of the POI with respect to the observation time, the separation distance, antenna elevations, the frequency of the signal, and the receiver bandwidths. We observe that the coincidence characteristic between the receiver scanning parameters and the signal parameters is the key factor to determine the time to obtain a given POI. This model can be used to find the optimal parameter combination to maximize the POI in a given scenario. We expand this model to a multiple system. This analysis is conducted on a personal computer to provide the portability. The model is also flexible and can be easily implemented under different situations.

THE EFFECT OF RANDOM VARIATION OF RADIOSONDE DATA ON THE PREDICTED FLIR PERFORMANCE CALCULATED BY THE PROGRAM UFLR

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The lack of correlation between the airborne Forward Looking Infrared Detector performance predicted by the program UFLR and the actual performance due to meteorological fluctuations was examined. Calculated performances for the detection, classification and identification of four surface targets using actual radiosonde profiles was compared to the performances obtained using radiosonde data affected by random atmospheric variations of pressure, temperature, and relative humidity. A total of 192 performances were created using this method. A graphical display and a statistical analysis of the actual and simulated performances was performed. Error margins were determine in the predicted detection ranges for height levels of 1,500 ft. and 10,000 ft. It was also determined that the FLIR performance may be degraded up to 10 nautical miles for a height level of 5,000 ft., and up to 12 nautical miles for a height level of 10,000 ft. due to the random atmospheric variations.

NAVAL AIRBORNE ESM SYSTEM ANALYSIS

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The purpose of this thesis is to evaluate Naval airborne tactical Electronic Support Measures systems based on particular operational requirements of the Ecuadorian Navy. The analysis is based upon the formulation of a time dependent Probability of Intercept as a measure of effectiveness. The model includes common parameters involved in the Electronic Support Measures process and relates them with various Electronic Warfare receiver techniques available for each mission.

A COMPARISON OF THE K-PULSE AND E-PULSE TECHNIQUES FOR ASPECT INDEPENDENT RADAR TARGET IDENTIFICATION

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It has been demonstrated that under laboratory conditions the natural resonant frequencies of a metallic scattering body may be used as the basis for target identification techniques. This thesis continues research into two such techniques; the difference equation based K-Pulse and the integral equation based E-Pulse. A double Gaussian smoothing function has been used in conjunction with the K-Pulse and basis functions of varying widths have been used in formulating the E-Pulse to provide enhanced performance in low signal to noise level environments. Digitally noise polluted synthetic scattered signals are used to analyze the effectiveness of the two techniques in distinguishing high, medium and low Q targets. Both methods are shown to merit further study as potential candidates for implementation as Resonance Annihilation Filters for real time target identification in a real world environment.

DEPLOYMENT OF CHAFF IN CENTROID MODE AGAINST ANTI-SHIP MISSILES USING A VARIABLE AZIMUTH AND ELEVATION LAUNCHER

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Chaff is the least expensive and simplest soft kill measure against anti-ship missiles. In this thesis, we study and simulate the deployment of the chaff in centroid mode for anti ship missile defense. The idea is to fire chaff of radar cross section greater than that of the ship, cause a shift of centroid and achieve break lock by moving the ship out of the radar resolution cell of the missile. After firing the chaff in an optimum direction, the ship is made to maneuver in two steps; first to make an earliest possible break lock and then to maximize its displacement from the missile line of flight. Since the interaction scenario is time variant, modelling has been structured on a relative coordinate system. The algorithms to implement these objectives are based on values extracted from this coordinate system centered on the chaff, mobile with the wind and oriented towards the missile. The mathematical model is translated into a simulation program. We consider it to be a good tool for insight and understanding and feel that it has a promise of application both in design work and at sea in the passive point defense problem.

EVALUATION OF VHF INTERCEPT AND DIRECTION FINDING SYSTEMS

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This thesis evaluates VHF Intercept and Direction Finding (DF) collection systems developed by ESL International, Watkin Johnson, and HRB Singer for induction into a divisional level signal battalion of the Pakistan Army. The introduction of the proposed system is expected to enhance existing intercept and Direction Finding (DF) capabilities. This thesis evaluates the three systems on the basis of performance, design, and supportability characteristics. In the process each system element is further broken into subelements composed of significant intercept and DF system characteristics. The expected threat environment and the capabilities of modern intercept and DF systems provided practical and workable rationale and criteria for this purpose. The conclusion is that the system developed by ESL International offers significant capabilities of meeting the needs of expected divisional level threat environments. A major recommendation is that the system capabilities be verified by carrying out a dedicated operational testing program before finalizing the acquisition proposal.

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(ASW)

BUBBLE DETECTION USING A
DUAL FREQUENCY SOUND FIELD

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The design, testing, and analysis of a dual frequency system to detect and determine the resonance frequency (and hence the size of bubbles ranging form 100-7 um radius) is reported. The resonance frequencies were compared to estimates based on the rise time of the bubbles. In general these comparisons agreed to within five percent. Although the system is not ideal for field measurements, it identifies important requirements concerning the size of the sample volume, the frequency and amplitude ranges of the sound fields and signal processing techniques to make an effective system. Bubbles are distinguished from non-gaseous particles by the nature of their nonlinear response to the dual sound field. The system is versatile and can be modified to suit many research purposes.

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(C3)

AN ASSESSMENT OF THE INTEGRATED SERVICES DIGITAL NETWORK IN SUPPORT OF COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE SYSTEMS

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Command, Control, and Communications - March 1989
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This thesis explores the technology of the Integrated Services Digital Network (ISDN) and assesses its value to strategic U.S. command, control, communications, and intelligence (C3I). The author provides a brief overview of how telecommunication systems support the concept of C2 and what some of the problems are in this area. A review of the ISDN concept is provided which serves as the foundation for assessing the significance of ISDN to the military and its value in meeting the particular telecommunication networks. Some of the more substantive issues of transitioning to ISDN are addressed such as network management and security. The author concludes that ISDN is an attractive long-term goal architecture. There are, however, several significant areas (applications, network management requirements, security architecture) that must be proactively addressed before ISDN is suitable for application in the C3I environment.

COMMAND AND CONTROL: AN INTRODUCTION

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Master of Science in Systems Technology
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The authors present an introduction to command and control (C2) and establish a foundation for understanding the complex nature of C2 and the C2 process. A historical perspective is presented which demonstrates the importance of C2 to national, military, and political objectives. The command and control process is described, and the basic characteristics of a C2 system are specified. The command and control structure of the United States military organization is presented. An introduction to the architecture of C2 systems is described, and a conceptual architecture of the C2 process is developed. The authors describe the U.S. strategic command and control structure and provide a basic description of the tactical warfighting doctrines and C2 structures of the U.S. Armed Forces including the wartime operations of the Coast Guard. The authors conclude with a fundamental approach to the process involving the evaluation of complex command and control systems.

INCORPORATING INFORMATION VALUE INTO NAVY TACTICAL DATA SYSTEM CONFIGURATION MANAGEMENT THROUGH THE DELPHI METHOD

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There is a difficulty in incorporating information value judgments into configuration management decisions regarding command and control systems. This work reviews two command and control process models, and decision theory as it relates to command and control and the current tactical data link configuration management method. The Delphi method is discussed and a means of incorporating its use into configuration management is introduced. The Delphi method would enable subjective assessments, such as perceived operational impact of tactical data link changes, to be systematically considered in Navy tactical data link configuration management decisions.

U.S. AND SOVIET STRATEGIC COMMAND AND CONTROL: IMPLICATIONS FOR A PROTRACTED NUCLEAR WAR
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This thesis will address the relative ability of the command and control systems of the United States and Soviet Union to support a protracted nuclear war. It will address the organizations as well as the various systems used to support the respective National Command Authorities. This includes the threat warning and attack assessment equipment used to determine strategic and tactical warning, the communications equipment used to alert forces of increased readiness and the contribution of these systems in the conduct of nuclear strikes, if required.

It also includes a review of the technical factors associated with the performance of C3 in a nuclear environment. The result is a net assessment of the two command and control systems that highlights the strengths and weaknesses inherent in each. Specific recommendations, such as better aircraft support schemes and more robust command and control system, are developed to help enhance the United States position regarding this vital national security issue.

PERFORMANCE ANALYSIS OF ALOHA NETWORKS WITH POWER CAPTURE AND NEAR/FAR EFFECT
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This thesis presents an analysis of the throughput characteristics for several classes of Aloha packet networks. Specifically, the throughput for variable packet length Aloha utilizing multiple power levels to induce receiver capture is derived. The results are extended to an analysis of a selective repeat Automatic Repeat Request (ARQ) Aloha network. Analytical results are presented which indicate a significant increase in throughput for a variable packet network implementing a random two power level capture scheme. Further research into the area of the near/far effect on Aloha networks is included. Improvements in throughput for mobile radio Aloha networks which are subject to the near/far effect are presented. Tactical Command, Control, and Communications (C3) systems of the future will rely heavily on Aloha ground mobile data networks. The incorporation of power capture and the near/far effect into future tactical networks will result in improved system analysis, design, and performance.

EXPERT SYSTEMS AND COMMAND, CONTROL, AND COMMUNICATION SYSTEM ACQUISITION

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This thesis examines the organizational causes of the Department of Defense's (DoD) inability to acquire working defense systems. One major cause of this is identified as a lack of a sufficient number of trained and experienced acquisition personnel. An examination of the definitions of Decision Support and Expert Systems is made to determine their suitability for application to this problem. The information system framework of Gorry and Scott Morton is used to structure the acquisition problem. The DoD acquisition problem is found to be a good candidate for the application of Expert Systems. An expert system architecture is developed to provide acquisition personnel both technical and management support. Use of a central mainframe, connected to the Defense Data Network will provide nationwide access, with centralized control of knowledge base. The architecture allows for the incorporation of existing conventional software under expert software control. In order to reduce development, cost and time, the use of existing DoD manuals, as the knowledge base, is proposed. A prototype module utilizing the M.1 expert shell and DoD Manual 4245.7-M and NAVSO P-6071 is developed to prove the feasibility of this approach.

A SPECIFICATION AND ANALYSIS OF THE IEEE TOKEN RING PROTOCOL

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Computer communications are becoming increasingly important in the command, control, and communications community. Using models to verify that the communications protocols used by these computers function properly is a time and effort saving device. A model called systems of communicating machines combines two types of models, finite state machines and programming language models. In this thesis, systems of communicating machines is used to specify and analyze the IEEE token ring protocol. The specification makes several simplifying assumptions about the protocol in order to make the analysis manageable. These simplifications include limiting the network to two machines and shortening the frame and token formats to reduce the number of transmissions on the network. This thesis exercises the resulting specification to both verify that the protocol won't fail and that the specification is correct. The type of analysis used in this thesis is called a reachability analysis or a system state analysis. This specification and analysis of the IEEE token ring protocol proves the protocol won't fail for a two machine network. This thesis also proves that the specification of the protocol is correct.

AN INTRODUCTION TO HUMAN FACTORS AND COMBAT MODELS

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This thesis discusses the incorporation of human factors into combat models. First, an historical perspective to determine the significant human factors of combat reveals that human factors fall into two categories based upon when they affect man the most: before/after the battle, and during the battle. Next, combat models are reviewed. Various purposes and model structures are discussed. Finally, incorporating human factors into combat models is discussed. It is argued that the model and the human factors must simultaneously be considered, for the selection of one influences the selection of the other. The structure and purpose of the model may limit which human factors can be considered. Analysis of the model's sensitivity to human factor representations will indicate which human factors are significant in that model. Furthermore, empirical data are lacking and not all human factors are mathematically representable at the current time. Some human factors, such as decision making, may be included using artificial intelligence techniques until data are obtained, if possible. When models and human factors are combined, the model must still be usable and understandable. The conclusion is that the human factors should be incorporated into combat models, step by step, as the data and mathematical representations are developed.

A COMMAND AND CONTROL WARGAME TO TRAIN OFFICERS IN THE INTEGRATION OF TACTICS AND LOGISTICS IN A FIELD ARTILLERY BATTALION

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Due to peacetime training limitation, the integration of tactics and logistics as it relates to the command and control of a field artillery battalion cannot be easily practiced. This thesis presents a computer assisted wargame which will give battalion staff officers some experience in dealing with this shortcoming. The wargame emphasizes the decision maker in the command and control system. Specifically, this wargame forces the decision maker to consider numerous tactic/logistics interface issues and then make a series of command and control type decisions. At the end of each game, the player's performance is evaluated in terms of howitzer availability time, casualty rates, vulnerability rates, and ammunition optimization. The wargame itself is highly flexible and is capable of being played in support of a full scale battalion command post exercise or during weekly officer professional development time.

COMMAND AND CONTROL SECURITY: CONCEPTS AND PRACTICES

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The United States is placing greater emphasis and reliance on command and control systems to be able to span the distances involved in, and keep pace with a modern battlefield. This greater reliance on command and control systems also creates a potential vulnerability to disruption or defeat through successful attacks against those same systems. Security is therefore of prime importance to the design and operation of command and control systems. The goal of this thesis is to provide students of command and control (C2), as well as designers and program managers of command and control systems, a basic understanding of the need for security in C2 systems and an introduction to security measures used to counter C2 threats. The ultimate objective of this thesis is to provide a conceptual framework for the continued study and analysis of command and control security and to emphasize the need for designing security into command and control systems as an integral component.

ORDER OUT OF CHAOS: A STUDY OF THE APPLICATION OF AUFTRAGSTAKTIK BY THE 11TH PANZER DIVISION DURING THE CHIR RIVER BATTLES 7-19 DECEMBER 1942

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Command, Control, and Communications - March 1989
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The U.S. Army's current AirLand battle doctrine emphasizes maneuver warfare. Coupled to this revision in doctrine, there has been no major update to U.S. command and control philosophy. The German Army of World War II also operated under a maneuver warfare doctrine. Its use of Auftragstakik, a command and control philosophy, provides valuable lessons for our Army from an historical perspective. This monograph presents an anatomy of the Chir River battles from a command and control, as opposed to a tactical, perspective. The brilliant defense of the German weak position against a numerically superior Soviet attacker provides an interesting parallel to the current situation faced by NATO units in Central Europe. Auftragstaktik should serve well as foundation from which the U.S. Army can develop a coherent command and control philosophy that complements that AirLand battle doctrine.

COMMAND AND CONTROL (C2) OVER THE MILITARY ROLE IN "COMMON DEFENCE"

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This thesis provides an overview of Command and Control (C2) over the military role in "common defence." The approach is to show the linkage between the American people and the operational performance of the U.S. military during combat. The Preamble to the Constitution and the basic definition of C2 stated in the Joint Chiefs of Staff (JCS) Publication 1 are used as the starting point for the thesis. From this point, a tracing of C2 in "common defence" is conducted. The focus is based on seven distinct levels of C2 in "common defence." These levels are hierarchical with a two-way vertical and horizontal flow of information. Low/High context and external transference are used to describe and trace the flow of C2 in "common defence" through the hierarchical levels. The thesis documents the actual means of decision making, planning, directing, influencing, coordinating, and/or controlling the operational performance of the military force.

A PROPOSED ARCHITECTURE FOR COMMUNICATION PLANNING IN SUPPORT OF MARINE AIR-GROUND TASK FORCE OPERATIONS

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Command, Control, and Communications - March 1989
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The author uses a systems approach methodology to address the requirements for a Marine Air Ground Task Force communication planner. An architecture is developed in which line of sight and beyond line of sight computer programs are used to assist the planner. Particular needs are stated for line of sight information requirements There is special emphasis on high frequency (HF) communication planning due to the vulnerability of satellite communications in a wartime environment. In particular, an algorithms for HF frequency communications is designed for HF frequency requests and for HF frequency to net assignments. That algorithm was coded by personnel at the Naval Ocean Systems Center (NOSC) and included as a test module in the latest release of the Advanced Prophet program. A menu driven program is designed and incorporates the features required for a Marine communication planner to enhance the command and control process for the commander.

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(SPACE SYSTEMS OPERATIONS)

A SURVEY OF PERMANENTLY MANNED LUNAR BASE CONCEPTS

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(Space Systems Operations) September 1989
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This thesis is a comparative evaluation of various lunar base concepts advocated by leading experts in the field of manned space exploration. Additionally, original design concepts are presented in four appendices. The emphasis is on the impact of mission strategy and objectives on lunar base design concepts. Three candidate mission scenarios involving a lunar base are compared: 1) a scientific research station, 2) a mining and manufacturing facility based on lunar resources, 3) a permanent, autonomous manned base or staging point for space exploration. The lunar base development stages are related to the evolution of the various mission alternatives. In addition, several lunar base design concepts are compared and evaluated in terms of function and construction techniques suitable for the lunar environment. Lunar base power sources are compared in terms of power output, complexity, and feasibility. Particular attention is given to the role of solar and nuclear power and the possible role of superconducting technology. Finally, the transportation infrastructure and logistics required to support an operational Moon base are examined, the primary focus being on mission modes, transportation costs, and supply logistics. This thesis concludes with a feasibility appraisal of a lunar base endeavor and surveys current lunar base study efforts.

MASTER OF SCIENCE
IN
TELECOMMUNICATIONS
SYSTEMS MANAGEMENT

METEOR BURST COMMUNICATIONS FOR THE
U.S. MARINE CORPS EXPEDITIONARY CORPS

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Meteor Burst Communications (MBC) is explored in relation to its usefulness to Marine Expeditionary Force Communications. A description of the physics and geometry of meteor trail propagation is presented. Communication techniques used to exploit the phenomenon are discussed. Current MBC circuits have operational ranges of 1200 miles without relay and maintain average data rates of 60 to 150 bits per Second (BPS). MBC is primarily limited by the physics and geometry of the propagation medium and its usefulness is bounded by its slow data rate. Within these boundaries however, several significant uses of MBC are identified.

STRATEGIC ISSUES IN NATIONAL SPECTRUM MANAGEMENT

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The demand for allocations and assignments in the radio frequency spectrum continues to grow in the United States and internationally. The unique properties of the spectrum combined with this growing demand have created a significant management challenge for the Federal Government. As a principal user of the spectrum, the military services are especially dependent upon the national spectrum management processes. Effective command and control of forces and optimum use of electronic sensory, navigation, and weapons systems are all contingent upon the ability to utilize the radio frequency spectrum. It is the responsibility of the national spectrum management process to encourage maximum utilization of the spectrum while maintaining electromagnetic compatibility. The importance of the spectrum to the military makes it imperative that the services develop a comprehensive strategy to protect the resources they currently have and help them to complete successfully for future requirements. This strategy must involve the development of clear national policy objectives relating to the spectrum, must contain guidance for improving the utilization of existing assignments, and must provide direction to new technology

AN ANALYSIS OF THE TOKEN RING PROTOCOL AS
SPECIFIEC IN ANSI/IEEE STANDARD 802.5-1985

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This thesis discusses the formal specification techniques for communication protocols and the ANSI/IEEE Standard 802.5 "Token Ring Access Method and Physical Layer Specifications," Background information on formal protocol specification and a review of the targeted standard are provided. The ambiguities that were found with the standard and solutions to some of those are presented. The study concludes that there is a growing need to find methods which will provide coherent, clear and unambiguous methods for the specification and analysis of communication protocols and standards.

A SYSTEMATIC APPROACH TO LOCAL AREA NETWORK ADMINISTRATION

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A systematic approach to Local Area Network (LAN) administration was presented to help new Administravit Science Department LAN lab staff member conduct management tasks. A two dimensional matrix was developed using this four LAN functional modules and five management task groups. Detailed task procedures were then prepared using rules developed for the functional modules.

WARGAMING COMMUNICATIONS FOR U.S. PACIFIC COMMAND (U)

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The Department of Defense is increasingly using war gamin as a training and analytical tool at the major fleet and theater level. The great, and growing, importance of command and control (C2) as an area of military science has focused interest on including realistic C2 play in war games. By doing so, it might be possible to determine the total tactical impact of C2 on engagement results and the outcome of battle. It is the premise of this thesis that individual C2 functions, specifically communications, can be adequately modeled and incorporated in theater level war games to aid in C2 analysis. The thesis presents an overview of war gaming, command, and control, and the communications systems of the U.S. Pacific Command and control, and the communications systems of the U.S. Pacific Command (PACOM). It then proposes a methodology for determining a communications model for PACOM, a set of criteria for selecting a simulation, and recommends a means of incorporating an existing simulation into the current PACOM war games.

PRICING AS A DEMAND MANAGEMENT TOOL FOR RECORD COMMUNICATIONS

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The Naval Telecommunications System (NTS), by achieving connectivity through various networks, provides record communications within the Navy. This service provided to a wide variety of user with different requirements. Currently, this service is provided without cost to the user. Because the service is free, there is no overt incentive to economize on its use. This may be one reason for an increase in message volume in past years. As a result of the overwhelming demand for record communications, the Naval Telecommunication System has experienced periods of delay in delivering messages to their destination. This thesis looks at how prices could be used as a demand management tool, to ensure messages reach their destination as prescribed by the originator. It also proposes a cost estimation model which, if implemented, could provide justifiable cost based on prices and serve as a basis for demand based and congestion based prices.

LEASE VERSUS BUY DECISION MAKING IN THE NAVY'S SATELLITE COMMUNICATIONS SYSTEMS

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This study provides a general analysis of the United States (U.S.) Navy's lease versus buy decision model in the satellite communications systems. It also examines the Leased Satellite (LEASAT) and the Ultra High Frequency (UHF) follow-on satellites. It gives general information on lease versus buy decisions in both the public and private sectors. It evaluates the inputs affecting the lease purchase decision, particularly the tax inducement and tax regulations lease buy decisions in the U.S. satellite communications sector. However, the analysis shows that cost considerations do not always receive top priority. Technical sophistication and risk, managerial considerations, and cash flow implications are among the other factors considered in lease buy analyses.

JOINT TACTICAL ANTI-JAM COMMUNICATIONS: A SYSTEMS APPROACH

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This study analyzes the conceptual design of a joint tactical anti-jam communication link from a systems point of view. It addresses the requirements and the specifications for a communication system providing an integrated solution for navies operating in closed sea areas under intense enemy jamming activity. The concept of the proposed system is based on spread spectrum technology and on the Joint Tactical Information Distribution System (JTIDS). Spread spectrum technology has been an area of extensive research for many years. Satisfactory practical solutions have been provided through the implementation of several frequency hopping systems and give partial answers to the anit-jam (AJ) problem. JTIDS is the only hybrid spread spectrum system intended to provide a catholic answer. The AJ performance of the proposed system is examined theoretically under realistic scenarios. System Feasibility, from the overall cost standpoint, is evaluated using life cycle costing and sensitivity analysis. The trade-off between the procurement of an original system and a JTIDS based design is also evaluated, based on possible research costs. It is assumed that acquisition or procurement of such a system is not limited by any technology transfer barriers.

SPREAD SPECTRUM FREQUENCY MANAGEMENT

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Because of the nation's increasing demand for more telecommunication capacity, there is a continuing need for more efficient ways of sharing the radio spectrum. The conventional ways of allocating the spectrum are by frequency, space, and time division. However, it is desirable to re-examine alternative procedures that might be necessary if the benefits of telecommunications are to be assured in the face of increased demand. Spread spectrum techniques, which are based on principles different than those currently used in spectrum allocation, seem to offer benefits for spectrum sharing and for some applications superior to those of frequency division. This thesis provides a summary of the principles upon which spread spectrum systems have developed and the progress of frequency management involving spread spectrum in frequency management and its role in future spectrum sharing opportunities.

A PRELIMINARY ECONOMIC EVALUATION OF MARINE CORPS ACQUISITION PRACTICES: UHF SATELLITE COMMUNICATION GROUND TERMINAL ACQUISITION

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Economic theories and concepts are used to discuss allocating scarce fiscal resource for acquiring UHF satellites communication ground terminals. The thesis provides an overview of current acquisition practices and suggests how applied economics can explicitly aid in better decision making.

FREQUENCY MANAGEMENT DATABASE MODEL (FMDM) FOR THE KOREAN ARMY COMMUNICATION SYSTEM AT THE REGIMENT UNITE LEVEL

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This thesis provides a frequency Management Database Model (FMDM) for the Republic of Korean Army (ROKA) Communication System. The FMDM uses a personal computer to increase the efficiency of the frequency management system at the regiment unit level in the Korean Army. A signal officer in the ROKA can use the FMDM for the allocation, planning, and distribution of radio frequencies, in order to achieve the optimum use of the frequency spectrum. A discussion of security has been included in this thesis so that both the hardware and software of the FMDM are protected.

MASTER OF ARTS
IN
NATIONAL SECURITY AFFAIRS

SOME PLANNING CONSIDERATIONS FOR JOINT OPERATIONS IN A MARITIME THEATER

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There are numerous interrelationships between joint operations, maritime theaters, operations or campaign planning, and combat. This thesis is an analysis of the British Turkish campaign of 1915, the German Norwegian campaign in 1940, and the U.S. Korean campaign in 1950 to discover some of these inter-relationships. For each campaign, the nation's joint service organization and strategic rationale is discussed in order to show its influence on operational planning. The plan for each of the campaigns is then presented, and compared to the actual combat which occurred during the execution of the plan. The analysis emphasizes two important purposes of the operation plan. First, the operational plan organizes means, space, and time in order to coordinate the actions of the (joint) forces available. Second, the operational plan communicates the intent of the operation to subordinates.

THE TRAINING AND EMPLOYMENT OF AREA SPECIALISTS IN THE MILITARY

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Advisor: E.J. Laurance - Department of National Security Affairs

This thesis examine the programs of study administered by the Army, Navy, Air Force, and Marine Corps used to qualify commissioned officers as specialists on foreign regions. The Foreign Area Officer (FAO) programs are compared and contrasted in terms of types of training, extensiveness of training, and how well each service balances academic work with practical experience. The post training missions of these officers are also reviewed. The opinions of FAOs concerning how well their training matched their later assignments is extensively examined by way of an original survey sent to 483 graduates of the Naval Postgraduate School National Security Affairs/Area Studies Masters degree program. Respondents are members of the Army, Navy and Air Force and data concerning both language training and graduate education is provided.

JAPANESE NATIONALISM

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This thesis addresses the phenomenon of Japanese nationalism, its changing place in Japanese life, and its influence on Japan's international relations. This study uses a theoretical-psychological approach to nationalism. After tracing the historical development of nationalist thought beginning in Tokugawa Japan, current social trends in the areas of politics, economics, women and family, and youth and education are examined to determine if the requisite qualities of nationalism are present in modern Japan to portend an eventual return to an ultra form of nationalism. The thesis concludes that traditional nationalist thought remains a vital part of Japanese thinking; and, concerning national security implications for the United States, the U.S. should not forcefully pressure Japan in the areas of trade and security issues. If U.S. policy is devoid of cultural sensitivity, Japan may exercise its options in unilateral defense buildup and trade preferences.

THE NUCLEAR THREAT TO THE CARRIER BATTLE
FORCE: THE PROBLEM AND THE ALTERNATIVES

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A comparison of U.S. and Soviet nuclear capabilities at sea suggests that escalation to nuclear warfare would significantly degrade U.S. carrier forces' chances for survival. While the Soviet Navy has seriously addressed the issue of nuclear war at sea, the U.S. Navy has given the problem less attention. Nonetheless, there are several credible escalation paths to nuclear war at sea. Four options for addressing the problem of carrier vulnerability are available: revising Navy force structure, preparing the present force structure for nuclear war, revising the Navy's strategies, and seeking a ban on tactical nuclear weapons at sea. Because none of these options appears capable of eliminating the problem, the Navy needs to recognize the nuclear threat in its training, tactics, and doctrine. Moreover, the Navy must scrupulously attend to the threat of nuclear attack in balancing the risks and benefits of aggressive forward carrier operations.

SOVIET COUNTERINSURGENCY

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The aim of this thesis is to determine the presence or absence of a Soviet doctrine of counterinsurgency and to identify the historical patterns of Soviet counterinsurgency. The thesis examines the place of counterinsurgency in Soviet military thought and compares the Soviet counterinsurgent campaigns in Soviet Central Asia, the Ukraine, Lithuania, and Afghanistan. The thesis concludes that a pattern of Soviet counterinsurgency evolved in spite of the absence of an official doctrine, but that the Soviet defeat in Afghanistan may inspire changes in the Soviet approach to counterinsurgency.

THE POLITICAL UTILITY OF NUCLEAR WEAPONS IN NUCLEAR WAR TERMINATION

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This thesis begins with a discussion of the theoretical aspects of nuclear war termination. Specifically, the objective, and the unclassified guidance available on war termination. As a more practical matter, the Soviet view of war termination is then covered. This is followed by a discussion of the goals of the United States in the event of a nuclear war and how those goals may change depending on the scenario. Finally, the surrender of Japan at the end of World War II is analyzed as a case study to determine the significant historical lessons which may of value in the future. Particular attention is given to the political actions which were taken as a result of the use of nuclear weapons.

THE UNITED STATES NUCLEAR POSTURE IN ITALY

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U.S. nuclear forces in Italy are vital to NATO's military posture for deterrence and defense. This thesis explores the historical, political, and military context of the U.S. nuclear posture in Italy. It also examines the several issues central to strategic planning in this area: Italian national defense interests, Soviet political-military strategy with respect to Italy and the Mediterranean, implications of the December 1987 INF treaty, and potential influences on the future of the U.S. nuclear posture in Italy.

THE FUTURE OF THE MEXICAN POLITICAL SYSTEM

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This thesis is an assessment of the viability and sustainability of the Mexican corporatist political system instituted in 1929. What is the future of Mexican politics over the next 20 years? Since 1929, this system of government has been the most stable in Latin America. There have been no presidential assassinations, no military coups, and no early departures from office: all the above being accomplished with a judicious blend of repression and cooptation. However, there are signs that the flexibility of this system is no longer sufficient to maintain government in its current form. Through a look at the causes of the 1911 revolution, the resulting political structure, the current problems, and the attempts at reform, what becomes apparent is that some type of change seems almost unavoidable. Just what this change might be, to include the timing and form of said change, is the focus of this thesis.

NET ASSESSMENT: AN EXAMINATION OF THE PROCESS

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Net Assessment is a systematic method of analysis that fulfills the need for an indirect decision support system and provides a major input to the strategic planning/management system in the Department of Defense. Through an established process of appraising two or more competitors as objectively as humanly possible, an analyst is guided to examine factors normally overlooked. Asymmetries that exist among competitors and the ability of a competitor to achieve its objective in various conflicts are examples of some of these factors. The net assessment process, useful applications of net assessment, and attempts to improve analysis are addressed in this thesis. These areas are examined to evaluate the effectiveness of net assessment as a method of analysis applicable to forecasting and policy modification.

OPTIMIZING THE POST-START U.S. STRATEGIC NUCLEAR MIX

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This thesis examines the impact a START agreement might have on United States and Soviet strategic nuclear forces. It then proposes an "optimum" post-START force mix for the U.S. and the Soviet Union. The current, as well as projected, post-START targeting policies are discussed. It is concluded that the impact of a START agreement on the current U.S. strategic targeting policy will be minimal. Although the target data base will not shrink as much as the forces tasked to cover it, a prioritization of targets is all that should be necessary with a post-START force. A START agreement will mean major reductions in U.S. and Soviet strategic nuclear forces.

As proposed in this thesis, only the ICBM leg of the Triad will require any major restructuring. This would include the addition of mobile ICBM systems. The SLBM and bomber legs will feel minimal changes (i.e., retiring POSEIDON SSBNs and retiring or converting some older B-52s). It is recommended that the B-2 program be cancelled, and funding be redirected into the mobile ICBM systems. By doing so, the United States could utilize technology available today to strengthen its forces and not gamble on the low observable technology which a "stealth" bomber might have.

TRANSITIONS FROM MILITARY RULE IN SOUTH AMERICA: THE OBLIGATIONAL LEGITIMACY HYPOTHESIS

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In recent years South America has witnessed a wave of transitions from military rule. These military regimes were different from past interventions in that the military came to power with their own agenda, not to specifically support an interest group, and they came to stay. This thesis examines the transition phenomenon from the military perspective, and hypothesize that these militaries chose to transition from power because of a breakdown in "obligational legitimacy" (a common identity within the military that justifies their right to rule). Specifically, a casual model in which obligational legitimacy is the dependent variable and nine casual conditions (both internal and external to the military organization) are the independent variables, is constructed and tested. This study considers the recent transitions in Argentina, Brazil, Peru, and Uraguay, and the non transition in Chile. It is concluded that a breakdown in obligational legitimacy is the key factor leading to the military's decision to leave power. This perspective offers new insights for analysis of transitions, future transitions, and United States foreign policy options regarding military regimes, regimes in transition, and the new democracies of South America.

POLITICAL AND TECHNICAL VERIFICATION ISSUES OF LIMITATIONS ON SEA-LAUNCHED CRUISE MISSILES

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This paper examines the political and technical verification issues associated with proposals to place quantitative and or qualitative limits on deployment of nuclear armed sea launched cruise missiles (SLCMs). Overviews of the army control relationship between the United States and the Soviet Union, the development of the SLCM, and Soviet and American concepts of verification are presented. The views of the American arms control and defense communities regarding the SLCM are discussed in depth, accompanied by a detailed examination of the various methods which have been proposed to verify a SLCM limitation agreement. The conclusion is that there are no technological barriers, per se, to SLCM verification, but as the decision on an agreement's verifiability is a political one, the U.S. Navy should concentrate its arguments against SLCM limitations on the weapon's operational utility rather than argue that such an agreement is unverifiable.

COCOM, TECHNOLOGY TRANSFER AND ITS IMPACT ON NATIONAL SECURITY

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This thesis looks at six key members of the Paris based, Coordinating Committee for Multilateral Exports (COCOM), as well as the Soviet methods of acquiring Western technology. The Soviet acquisition of Western technology is a pressing concern for the Western world and will continue to grow. In analyzing the shortcomings of COCOM and the policy making process in West Germany, Great Britain, United States, France, Italy, and Japan, various propositions are identified which explain the flow of technology moving east. Critical variables include: the informal nature of COCOM itself, each country's commercial orientation, the lack of national security input when conducting export transactions, the specific country's political will and technological proficiency, the amount of trade the specific country does with the Soviet bloc in conjunction with their export process, laws and sanctions against violators, as well as their participation within the COCOM. Policy remedies based on the research are suggested.

RAMIFICATIONS OF ILLEGAL U.S. ARMS EXPORTS

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This thesis examines the impact of illegal U.S. arms transfer upon recipient nations war fighting capabilities and upon the American national security. Data was gathered primarily from U.S. District Court records and interviews with U.S. governmental officials form intelligence services and the Department of Commerce, Justice and State. An investigation of the illicit arms transfers to Iran formed the basis of conclusions reached. Additionally, policy recommendations are provided to enhance the governmental detection and investigation of illegal export violations. The viability of utilizing court documents as intelligence tools for measuring military capabilities is assessed.

THE UNITED STATES AND INDIA: STRATEGY FOR THE 1990s

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This thesis recommends a policy shift based on evidence which shows that the United States could benefit from an improvement in relations with India. The problematic US-Indian relationship is traced from its inception in 1947. Political, economic and strategic benefits available through a policy shift are outlined. The most significant gain would be in the strategic sense, with India as a dominant regional actor maintaining regional peace and stability while keeping trade and communications lanes open. A concomitant and almost equally important benefit of such a policy shift would be the added political prestige or influence of the United States, especially with the Third and Non-Aligned Worlds. Finally, India represents significant economic potential for US investment and export. This study will also examine the risks inherent in the policy recommended.

A COMPARISON OF U.S. AND SOVIET STRATEGIC DEFENSIVE DOCTRINE

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This thesis examines the strategic defensive doctrines of both the Soviet Union and the United States, and further explores the concrete manifestations of the disparities in those doctrines. The evolution of the defensive components of national strategies is traced from the end of World War II to the present, and specific defensive systems are described. The focus is on the impact of strategy on deployment of antiballistic missile systems, antiaircraft defenses, and civil defense programs. A comparison of current strategic defensive deployments highlights the differences in the doctrines adopted by the two nations. While the Soviet Union has deployed substantial defensive systems, the United States has chosen to forego all but minimal antiaircraft defenses. This basic difference in strategic through may be, itself, destabilizing.

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