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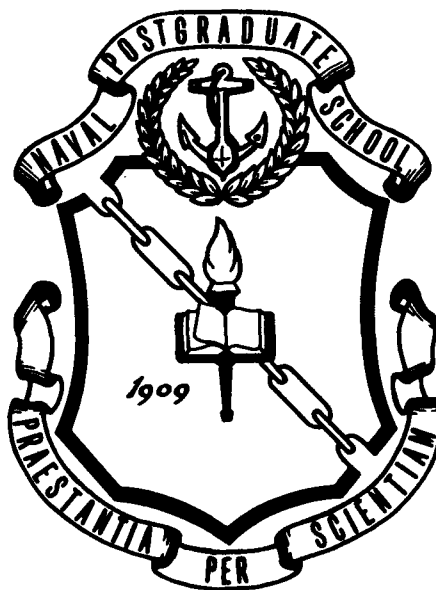
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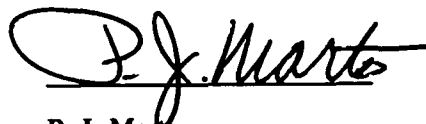
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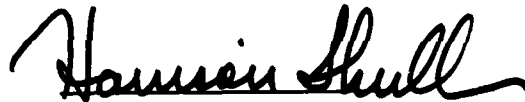
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**DOCTOR
OF
PHILOSOPHY**

A TYPE CALCULUS FOR MATHEMATICAL PROGRAMMING MODELING LANGUAGES

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M.S., Naval Postgraduate School, 1984

Doctor of Philosophy in Operations Research - September 1990

Advisor: G. H. Bradley - Department of Operations Research

The issue of model validation is critical in the formulation and interpretation of mathematical programming models, yet this problem is largely ignored by contemporary modeling languages and the systems they support. This research advances modeling languages for mathematical programming by providing a formalism and defining a language for specifying a dimensional complement, called "typing," to the algebraic representation of models. Typing is a formal specification used to determine automatically whether the algebraic model is well-formed in the sense that its objective function and constraints are composed of homogenous components and that operations performed using indices are meaningful. A provision is made for the definition of dimensional axioms that can be applied automatically to resolve dimensional differences. The addition of formal typing to mathematical programming models also yields a powerful abstraction mechanism for integrated modeling.

DEPENDENCE OF RADAR BACKSCATTER ON THE ENERGETICS OF THE AIR-SEA INTERFACE

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Doctor of Philosophy in Physical Oceanography - December 1989

Advisor: E. B. Thornton - Department of Oceanography

The Normalized Radar Cross-Section (NRCS), the fundamental measurement made by radar scatterometers, was obtained as part of the Water-Air Vertical Exchanges 1987 (WAVES87) experiment. The experiment was designed to evaluate the effects of environmental parameters on the NRCS and was performed from a research tower located in Lake Ontario, on which two microwave scatterometers operating at 14.0 and 5.0GHz were installed for six weeks in the autumn of 1987. The novel aspect of this experiment was that the 14.0GHz radar automatically rotated through 300° in azimuth angle at six different incidence angles to the water surface, accompanied by simultaneous measurements of wind stress and high resolution directional wave spectra. Therefore, the incidence and azimuthal angle behavior of the NRCS was examined as a function of wind speed, friction velocity, wind direction, wave direction and atmospheric stability. The dependence of the NRCS on wind speed for various incidence angles is similar to previous results. However, the slope exponents of the NRCS vs. 19.5m wind speed curves at intermediate incidence angles are higher than the corresponding open ocean measurements. Scaling the lake neutral wind speed data by the ratio of lake to ocean drag coefficients reduces the slopes of the curves and suggests the drag coefficient has a sea state dependence. The correlation between NRCS and neutral wind speed at 1m is higher (0.91) than between the NRCS and friction velocity (0.73 at 40°). The minima in the sinusoidal modulation of the NRCS as a function of relative wind angle (the angle between the wind and antenna directions) are often shifted (by as much as 45°) such that the minima do not always occur at cross-wind angles. Instead, the angular distance between the NRCS minima in the case of a wind-wave sea appears to approximate the directional spread of the waves about the upwind direction, generally rather less than 180°. The degree of sinusoidal modulation of the NRCS with relative wind angle is highly correlated with significant slope and inverse wave age at 20° incidence angle (0.90) and moderately correlated at 40° (0.75); i.e., increased azimuthal modulation at 20° is associated with a steeper wave field. The dependence of the NRCS on atmospheric stability shows the NRCS to decrease by about 5dB between air-water temperature differences of about -16 to + 10°C. This stability effect is removed by parameterization of the NRCS in terms of either the friction velocity or neutral wind speed at 1m, with the neutral wind speed providing the best normalization of the data. The results show that radar scatterometers are an especially sensitive means by which to study the air-sea interface: the magnitudes of the 5.0GHz and 14.0GHz NRCS respond nearly instantaneously to changes in the near-surface neutral wind speed, but the directionality of the (Ku-band) NRCS is the result of complicated interrelationships among the influencing environmental variables.

**AN ASSESSMENT OF DATA REQUIREMENTS FOR QUASIGEOSTROPHIC NOWCASTS
AND HINDCASTS OF A MESOSCALE EDDY FIELD IN THE CALIFORNIA CURRENT
SYSTEM WITH APPLICATION TO FALL TRANSITION**

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B.S., United States Naval Academy, 1973

M.S., Naval Postgraduate School, 1980

Doctor of Philosophy in Physical Oceanography - March 1990

Advisor: C. N. K. Mooers - Department of Oceanography

An extensive Ocean Prediction Through Observation, Modeling, and Analysis (OPTOMA) domain, off Northern and Central California, was surveyed in November 1986, during OPTOMA 23. Surface dynamic height (SDH), sea surface temperature (SST), and other fields were mapped with a Gandin objective analysis (QA) model; stream function nowcasts and hindcasts of the mesoscale oceanic field were generated by a quasigeostrophic (QG) model, initialized and updated with OA fields of dynamic topography. The westward propagation, at 5-to-10 km/day, of an anticyclone was the predominant mesoscale event; cyclonic features were quasi-stationary. Surface velocities, estimated from changes in SST patterns observed in pairs of satellite images, were consistent in direction with geostrophic surface velocities and ca. twice the magnitude, as expected from their increased spatial resolution. Altimetric sea surface height (SSH) fields were consistent with SDH fields. A simulation of the GEOSAT sampling pattern reproduced the SDH field accurately using two ascending and four descending orbits. Hence, GEOSAT altimetry can be effective in mapping the mesoscale variability of the California Current System (CCS). The impact of data upon QG nowcasts/hindcasts was evaluated by incorporating wind stress and bottom topography and subsampling an in situ data set. Ten-day hindcasts of the upper level stream function and the temperature at 100 m (T100), derived from an empirical relation with the vertical derivative of the stream function, were compared with climatology, persistence, and a verification field. The optimal QG model configuration, for this case, was: interpolated boundary conditions, no bottom topography, and no wind stress curl forcing. The Generalized Digital Environmental Model (IGDEM), the Navy standard climatology, had accurate averages and ranges of values, but it did not represent the mesoscale field. Because the mesoscale field did not change much over the ten-day period, persistence fields scored well. QG hindcasts were most sensitive to data density: the one-half subsampled fields scored well and the one-eighth fields were poor. Even in the latter case, the model filled data gaps and areas of cyclonic and anticyclonic activity were adequately delineated. Poorly initialized fields were recovered with good boundary condition updates; hindcasts using simulated GEOSAT and Sofar data located features accurately, but were noisy and had a range of values lower than the verification field. T100 fields extracted from the hindcasts were accurate. The Fall Transition of 1986 in the CCS was a chronic event; winds favorable for upwelling fluctuated and diminished in late October, but occurred during short periods through December. A balance of alongshore pressure gradient and wind stress at Monterey shifted from maximum southward in late November to maximum northward two weeks later. The northward nearshore flow was observed in satellite imagery, SDH and SSH OA fields, and in QG hindcasts. An increase in SST at NDBC buoys and Granite Canyon was also consistent with the Fall Transition. Near surface warming, expected nearshore during the Transition, was observed to ca. 300 km offshore in OA and T100 fields.

APPLICATION OF CHAOS METHODS TO HELICOPTER VIBRATION REDUCTION USING HIGHER HARMONIC CONTROL

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Doctor of Philosophy in Aeronautical Engineering - March 1990

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Chaos is a discipline used in understanding complex nonlinear dynamics. The geometric and topological methods of Chaos theory are applied, for the first time, to the study of flight test data. Data analyzed is from the McDonnell Douglas OH-6A Higher Harmonic Control (HHC) test aircraft. HHC is an active control system used to suppress helicopter vibrations. Some of the first practical applications of Chaos methods are demonstrated with the HHC data. Although helicopter vibrations are mostly periodic, evidence of chaos was found. The presence of a strange attractor was shown by computing a positive Lyapunov exponent and computing a non-integer fractal correlation dimension. Also, a broad band Fourier spectrum and a well defined attractor in pseudo phase space are observed. A limit exists to HHC vibration reduction due to the presence of chaos. A new technique based on a relationship between the Chaos methods (the Poincare section and Van der Pol plane) and the vibration amplitude and phase was discovered. This newly introduced technique results in the following: 1) it gives the limits of HHC vibration reduction, 2) it allows rapid determination of best phase for a HHC controller, 3) it determines the minimum HHC controller requirement for any helicopter from a few minutes duration of flight test data (for the OH-6A, a scheduled gain controller for HHC appears to be adequate for steady level flight), 4) it shows that the HHC controller transfer matrix is linear and repeatable when the vibrations are defined in the "Rotor Time Domain" and that the matrix is nonlinear and nonrepeatable when the vibrations are defined in the "Clock Time Domain." This technique will reduce future HHC flight test requirements. Further, the technique does not require the helicopter to be equipped with HHC. These methods may be applicable to other vibration control and flight testing problems.

INTERFEROMETRIC SAR IMAGING OF OCEAN SURFACE CURRENTS AND WAVEFIELDS

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M.S., Naval Postgraduate School, 1988

Doctor of Philosophy in Physical Oceanography - June 1990

Advisor: E. B. Thornton - Department of Oceanography

The potential of a relatively new method to remotely measure near-surfaced currents and dominant wave spectra using Interferometric Synthetic Aperture Radar (INSAR) is demonstrated. INSAR consists of a single conventional SAR augmented by an additional receiving antenna. The phase difference between corresponding SAR image scenes are observed by the antennas provides an interferogram that is directly proportional to the ocean surface velocity field. This direct motion detection by INSAR suggests a significant advance compared with conventional SAR where the response to the moving ocean surface is indirectly related to the complex modulation of the surface reflectivity by longer waves and currents. An experiment using an airborne implementation of INSAR to measure ocean surface currents and wavefields, compared with simultaneous ground truth measurements using Lagrangian drifters and wave array data was conducted in Monterey Bay. INSAR measured mean current magnitude estimates agree to within 10 percent compared with conventional measurements. The INSAR image wavenumber spectrum is consistent with the *in situ* directional spectrum and with predicted numerical reflection model outputs. The wavelength of the observed swells are in better agreement (correlation better than 0.9) than wave direction. An attempt to estimate the scene coherence time for L-band SAR was made by taking advantage of the almost simultaneously acquired SAR and INSAR images. The obtained mean scene coherence time $O(100 \text{ msec})$ is consistent with sparse observed estimates in the literature. This limited radar temporal coherence, caused by the velocity spread of short waves, degrades the azimuthal resolution of SAR and INSAR and depends on the sea state and radar wavelength. The experimental results show that the finite scene coherence time has a dominant role on the distortion of the INSAR (and SAR) image spectrum relative to the ocean wave spectrum. The present study introduces limitations of interferometric SAR configuration in imaging nonstationary scenes like the ocean surface.

**PARAMETRIC MODELING AND ESTIMATION OF PULSE PROPAGATION ON
MICROWAVE INTEGRATED CIRCUIT INTERCONNECTIONS**

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B.S., North Carolina State University, 1975

M.S., Naval Postgraduate School, 1985

Doctor of Philosophy in Electrical Engineering - June 1990

**Advisor: M. Tummala - Department of Electrical and
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The modeling of picosecond pulse propagation on microwave integrated circuit interconnections is considered. Autoregressive moving-average (ARMA) and autoregressive (AR) parametric models are derived for lossy dispersive microstrip transmission lines and cascaded microstrip step discontinuities. We formulated mathematical expressions to relate the model parameters to the physical microstrip properties. New lumped-distributed equivalent circuit models are presented. Dispersive pulse propagation on high-frequency integrated circuit interconnections is modeled using frequency-dependent lumped parameters and lossy distributed transmission-line sections. We verified the equivalent circuit models through computer simulations and experimental measurements. Modern parameter estimation techniques are applied to system identification modeling. We develop several algorithms to estimate the model parameters from input and/or output measurements. The performance of the algorithms are evaluated using computer simulations and experimental results.

**AERONAUTICAL
ENGINEER**

COMPUTER GRAPHICS ADAPTATION OF SEVERAL AERODYNAMIC PREDICTION PROGRAMS

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Aeronautical Engineering - December 1989

Advisor: J. Val Healey - Department of Aeronautics and Astronautics

This thesis describes the modification of six computer programs on the Micro VAX/2000/CAD/CAE workstation. Three of the programs, NEW DOUBLE, NEW PANEL, and NEW VOR, were originally transferred to the Aeronautical Engineering VAX System Server by LCDR John Campbell. Two of the programs (SUB and SUPER), both vortex lattice method programs, were placed in the VAX system by Mr. Rich Margason of the Langley Research Center. None of the above five programs had any graphics facility. The sixth program, a viscous interaction program was transferred/adapted to the VAX system by the author of this report. Extensive modifications were subsequently made to these programs to enhance their user interface. In addition, all the programs have been adapted to provide interactive graphical/printed output. Furthermore, program NEW DOUBLE was modified to accept any arbitrary symmetrical shaped body. Lastly, NEW PANEL was altered to interface with a viscous interaction effects program in which the boundary layer characteristics are determined. All user inputs in NEW DOUBLE, NEW PANEL and NEW VOR were backed up with interactive checking routines. The programs are intended to be used by aeronautics/astronautics engineering students in basic and advanced courses in aerodynamics.

CALIBRATION OF THE NAVAL POSTGRADUATE SCHOOL

3.5' X 5.0' ACADEMIC WIND TUNNEL

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M.S., Naval Postgraduate School, 1990

Aeronautical and Astronautical Engineer - September 1990

Advisor: L. V. Schmidt - Department of Aeronautics and Astronautics

The purpose of this thesis was to revitalize the Naval Postgraduate School's 3.5' X 5.0' academic wind tunnel. The wind tunnel had sustained previous damage to one of two sets of counter-rotating blades. The damage forced the operation of the tunnel on one set of blade. Because of this change in configuration a wind tunnel calibration was deemed necessary. Along with the calibration a digital data acquisition system was designed and implemented to aid in the data collection, storage and analysis for this project and future projects utilizing this wind tunnel. The test section airspeed calibration data contained a substantial amount of scatter indicating flow straighteners may be required. The wind tunnel turbulence intensity was found to be relatively low considering the configuration change and is expected to reach an acceptable level (less than 0.3 percent) with the planned installation of turbulence screens in the settling chamber.

APPLICATIONS OF NEURAL NETWORKS TO ADAPTIVE CONTROL

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M.S.A.E., Naval Postgraduate School, March 1989

Aeronautical Engineer's Degree - December 1989

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The amount of a priori knowledge required to design some modern control systems is becoming prohibitive. Two current methods addressing this problem are robust control, in which the control design is insensitive to errors in system knowledge, and adaptive control, in which the control law is adjusted in response to a continually updated model of the system. This thesis examines the application of parallel distributed processing (neural networks) to the problem of adaptive control. The structure of neural networks is introduced, focusing on the Backpropagation paradigm. A general form of controller consistent with use in neural networks is developed and combined with a discussion of linear least squares parameter estimation techniques to suggest a structure for a neural network adaptive controller. This neural network adaptive control structure is then applied to a number of estimation and control problems using as a model the longitudinal motion of the A-4 aircraft. The purpose of this thesis is to develop and demonstrate a neural network adaptive control structure consistent with adaptive control theory.

**DYNAMIC ANALYSIS OF THE LOW POWER ATMOSPHERIC
COMPENSATION EXPERIMENT (LACE) SPACECRAFT**

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Master of Science in Aeronautical Engineering and

Aeronautical Engineer - June 1990

Advisor: R. Kolar - Department of Aeronautics and Astronautics

The Low Power Atmospheric Compensation Experiment (LACE) spacecraft was launched for NRL in February 1990. The LACE flight dynamics experiment will provide on-orbit system identification of the LACE spacecraft. The experiment is designed to measure modal frequencies, damping ratios, and oscillation amplitudes of the LACE spacecraft. The purpose of this study is to develop a finite element model of the LACE spacecraft and conduct a dynamics analysis to determine natural frequencies and mode shapes. Four configurations of the spacecraft are analyzed. This data will be compared actual orbital data and will provide an opportunity for improvements in the accuracy of computer simulations of flexible structures and multi-body dynamics. Thermoelastic effects due to differential heating are addressed to check the magnitude of deformations that may cause a problem for stability or on-orbit identification. The final phase of this study is to conduct a parametric analysis of the spacecraft boom to investigate the presence of chaotic vibration for combinations of excitation amplitude and frequency.

**ELECTRICAL
ENGINEER**

**ERROR PROBABILITIES OF FREQUENCY-HOP MFSK WITH SELF-NORMALIZATION
COMBINING IN A FADING CHANNEL WITH PARTIAL-BAND INTERFERENCE**

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Master of Science of Electrical Engineering and Electrical Engineer - June 1990

Advisor: T. T. Ha - Department of Electrical and Computer Engineering

Research entails derivation statistical description of output from an MFSK receiver which uses self-normalization of the output from quadratic detectors. The system uses fast frequency hopping to provide diversity and assumes independent channels for each hop when the signal is recombined. The effects of fading channels are investigated for both Rayleigh and Rician fading channel descriptions. Probability of bit error for the uncoded performance is plotted for various signal-to-noise ratios (SNR) and different levels of diversity versus worst-case partial-band jamming. Analysis for Forward Error Correction coding is included for rate 1/2 and 1/3 convolutional codes and (n,k) Reed-Solomon Block codes. Probability of bit error is plotted for each code with various signal-to-noise ratios and diversity levels 1 to 4 versus worst-case partial-band jamming.

**NOISE ADAPTATION AND CORRELATED MANEUVER GATING OF AN
EXTENDED KALMAN FILTER**

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Electrical Engineer's Degree - March 1990

**Co-Advisors: H. A. Titus & H. H. Loomis - Department of Electrical
and Computer Engineering**

Extended Kalman filtering is used to provide estimates of the position and velocity of a target based upon observations of the target's bearing and range. Non-stationary noise is shown to degrade the performance of the filter and cause filter divergence. By estimating the noise power from the variance of the filter's residual we adapt the filter to compensate for varying noise power. We also introduce the method of correlated maneuver gating to adapt the Kalman filter to target dynamics. By spatially and temporally correlating the Mahalanobis Distance of the residual, the Kalman filter's performance is increased while tracking tangentially accelerating target's. Monte Carlo simulations are run for three different sets of target dynamics: stationary, moving linearly, and accelerating tangentially. Results for the simulations show significant performance advantages of using correlated maneuver gating in conjunction with noise adaptation. These results should generalize to other applications of the extended Kalman filter whose state and observation spaces enjoy a one-to-one mapping.

VLSI DESIGNS FOR PIPELINED FFT PROCESSORS

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Master of Science in Electrical Engineering and

Electrical Engineer - June 1990

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Computer Engineering**

A system of custom cell building blocks utilizing scaleable CMOS technology is described. The cells are designed to support the high speed, pipelined addition, subtraction, and multiplication operations necessary in a cyclic spectral analyzer or other applications involving the FFT. The cells are structured in such a manner as to permit a designer to tailor the bit-length of the operations and the number of pipeline stages used. Both fixed and floating operations are supported by the system. The size and performance characteristics of devices produced using the cells are compared with previously produced Genesil Silicon Compiler pipelined designs. The appendix contains designs of a 16-bit mantissa, 12-bit exponent floating point multiplier and adder produced from the standard cells. If fabricated in 1.2- μ feature size technology, the theoretical maximum clock speed and throughput rate is 102 MHz with an asymmetric clock and 61 MHz using a symmetric clock waveform. Devices with clock speeds up to 178 MHz are possible if the number of logic cells between a pipeline stage is reduced to one.

**AN ANALYSIS OF MLAYER: A MULTILAYER TROPOSPHERIC
PROPAGATION PROGRAM**

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B.ENG.(Hons), National University of Singapore, 1983
MSc(E.E), National University of Singapore, 1987
Master of Science in Electrical Engineering and
Electrical Engineer - June 1990
Advisor: H. M. Lee - Department of Electrical and
Computer Engineering**

MLAYER, a computer program, was developed by the Naval Ocean Systems Center (NOSC) for calculating the signal levels of electromagnetic waves propagating in a multilayer tropospheric waveguide environment over seawater. The program is an extension of the XWVG which is a trilinear ducting program. Modifications of the XWVG were carried out to handle multilayer tropospheric ducts. A number of modifications and improvements on the program made over the past several years were not documented. A detailed documentation of MLAYER was also not available. The objective of this study is to develop a technical documentation for MLAYER using the program as baseline. The study aims to put together the theoretical formulations (specific to MLAYER) into a complete self-contained document. This is to facilitate potential users with better appreciation of the capabilities, limitations, approximations and assumptions used in the mathematical modelling techniques. As far as possible, the same terminologies and functional variables used by Baumgartner (in the XWVG development) and by Pappert (in the MLAYER development) are adopted to enable one to relate this document to the program. Step-by-step derivation of certain equations was carried out and checked for compatibility with the algorithm in the program. An in-depth scrutiny of each program element was also conducted and a description for each is provided. As a result of a detailed analysis of the respective algorithm in the program, the documentation for the evaluation of the modal function was eventually prepared. Additional materials were gathered from technical reports and papers to supplement the development of this document. The MLAYER supporting programs (Microsoft program maintenance utility "makefiles") were modified to enable the program to run on Microsoft FORTRAN version 5.0. MLAYER was tested and ran successfully on Microsoft FORTRAN version 5.0. and C compilers version 5.0.

**MECHANICAL
ENGINEER**

**FURTHER DEVELOPMENTS OF FILMWISE CONDENSATION
OF STEAM ON HORIZONTAL INTEGRAL FINNED TUBES**

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Master of Science in Mechanical Engineering & Mechanical Engineer - June 1990

Advisor: P. J. Marto & S. B. Memory - Department of Mechanical Engineering

Heat transfer measurements have been made for filmwise condensation of steam on three families of horizontal integral finned copper tubes. The families differ from each other in their tube root diameter (12.7mm, 19.05mm, 25.00mm). The tubes making up each family differ from each other only in the fin spacing. Similar measurements have been carried out on three smooth horizontal copper tubes of outside diameters equal to the root diameters of each family, allowing the heat transfer enhancements due to the fins to be measured directly. Results carried out under vacuum and atmospheric conditions indicate that there is an optimum fin spacing which is independent of tube root diameter and operating pressure. This optimum fin spacing is 1.5mm. Heat transfer measurements were carried out on all tubes with and without the use of a spiral insert (used to enhance the internal heat transfer). It was found that with the current processing technique used, the heat transfer enhancement for a finned tube (which is based on the outside heat transfer coefficient) varies depending on whether or not an insert is used, the enhancement being lower when no insert is used. However, it was found that when testing a smooth tube there was no difference when an insert was or was not used. There is a need to develop a more accurate correlation for the inside heat transfer coefficient. Further tests have been repeated using a finned tube geometrically similar to one being tested at the University of London. Discrepancies that existed between the two sets have been eliminated.

A COMPUTATIONAL AND EXPERIMENTAL STUDY OF FLUSH HEAT SOURCES IN LIQUID

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Master of Science in Mechanical Engineering and

Mechanical Engineer - June 1990

Advisors: Y. Joshi & S. Sathe - Department of Mechanical Engineering

A numerical investigation of two-dimensional natural convection flow and heat transfer from a substrate-mounted flush heat source immersed in a liquid-filled square enclosure was conducted. The study is relevant to direct liquid-immersion cooling of electronic components. A control volume based finite-difference model that accounts for conduction heat transfer within the substrate and heat source and the coupled natural convection in the fluid was utilized. Numerical predictions were obtained for a wide range of Rayleigh and Prandtl numbers, substrate to fluid and heat source to fluid thermal conductivity ratios and other geometrical parameters that may be encountered in practice. An increase in Rayleigh number lead to more vigorous flow and promoted cooling. No noticeable effect on the nondimensional temperatures was observed when changing the Prandtl number from 7 to 100. Little reduction in maximum temperatures was observed when substrate and component to fluid thermal conductivity ratios were increased beyond 10 and 25, respectively. Component to substrate width ratio change from .25 to .999 resulted in approximately linear decrease in the maximum temperature. A companion experimental study of three-dimensional natural convection transport from a flush mounted array of heat sources in water was also conducted. Computer temperatures compared favorably to appropriate experimental data.

**AUTOPILOT DESIGN FOR AUTONOMOUS UNDERWATER
VEHICLES BASED ON SLIDING MODE CONTROL**

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M.B.A., University of Central Florida, 1985

Master of Science in Mechanical Engineering and

Mechanical Engineer - June 1990

Advisors: F. A. Papoulias & A. J. Healey -

Department of Mechanical Engineering

An autopilot is designed using Sliding Mode Control Theory that can control the speed and heading of a full six degree of freedom, nonlinear model of the Navy's SDV Mark 9 vehicle. The control laws are based on a simplified linear model that allows speed and heading to be treated as separate systems. Once control of heading and speed is established, depth control is then achieved by a third law. Although they are developed separately, the three individual control laws act simultaneously to provide robust control of speed, heading, and depth of the nonlinear model of vehicle. Line of Sight Guidance is used to convert the way points provided by the mission planner into commands for heading to which the autopilot responds. The performance of the autopilot is evaluated over a wide range of speeds to demonstrate its robustness. In addition, the effects of current are simulated and the autopilot is modified to compensate of the presence of a strong current.

**INTERACTION OF A VORTEX PAIR WITH A FREE SURFACE:
MEASUREMENTS AND COMPUTATIONS**

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Master of Science in Mechanical Engineering and

Mechanical Engineer - June 1990

Advisor: T. Sarpkaya - Department of Mechanical Engineering

An investigation of the interaction of two counter-rotating vortices with a free surface has been undertaken. Experiments were carried out in two water basins and in a long towing tank through the use of measurements, flow visualization, and an infra-red camera. The results have shown that all types of vortex pairs over a wide range of Froude Numbers give rise to three-dimensional surface disturbances, known as scars and striations. The striations are a consequence of the short wavelength instability inherent to the vortex pair itself. The scars are transported outward by the vortex pair and are comprised of a constellation of coherent vortical structures (whirls). The experiments have provided sufficient understanding of the physics of the phenomenon and led to the development of a numerical model based on vortex dynamics. This model proved to be capable of explaining the physical processes involved in the evolution of the three-dimensional footprints of the vortex pair.

**MASTER OF SCIENCE
IN
AERONAUTICAL
ENGINEERING**

**AN EXPERIMENTAL INVESTIGATION INTO NO_x CONTROL OF A GAS TURBINE
COMBUSTOR AND AUGMENTOR TUBE INCORPORATING A CATALYTIC
REDUCTION SYSTEM**

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Master of Science in Aeronautical Engineering - March 1990

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

An initial experimental investigation was conducted to examine the feasibility of NO_x emission control using catalytic reduction techniques in the jet engine test cell environment. A modified T-63 gas turbine combustor and an augmentor tube, 21 feet in length and containing a perlite catalyst, were used as a gas generator and catalytic reduction system. Four data runs were made. Three runs were completed without the catalyst installed. Temperature and velocity profile measurements were obtained in order to calculate augmentation ratios for different engine fuel to air ratios. NO_x, CO, and unburned hydrocarbon concentrations in the exhaust were measured to provide a baseline for further tests. A fourth data run was made with the perlite catalyst installed in the augmentor tube. A 64 percent NO_x reduction was observed, however, the large pressure drop across the catalytic bed deemed the current configuration impractical. Recommendations for alternative configurations are presented. The results of the investigation have proven that further study is warranted.

**AIRCRAFT CONFIGURATION STUDY FOR EXPERIMENTAL 2-PLACE
AIRCRAFT AND RPVS**

**Gary Douglas Black - Lieutenant Commander, United States Navy
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Master of Science in Aeronautical Engineering - March 1990

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

A performance comparison and tradeoff study was conducted between eight unique aircraft configurations for high performance light aircraft and remotely piloted vehicles. These configurations included conventional tractor, conventional pusher, canard, tandem-wing, joined-wing, flying-wing and 3-surface designs, which were analyzed through the use of microcomputer-based performance and lattice vortex programs. Actual experimental aircraft were utilized as models which were geometrically scaled to a useful load of 600 pounds and given a common powerplant of 115 horsepower. The joined-wing, tandem-wing and conventional pusher were found to exhibit enough improvement over a conventional tractor configuration to warrant serious consideration for design selection. The performance and stability programs were reasonably accurate predictors of aircraft performance when given actual aircraft parameters and thus judged as reliable estimators of scaled aircraft performance.

**A FLOW VISUALIZATION STUDY OF LEX GENERATED VORTICES ON A SCALE
MODEL OF A F/A-18 FIGHTER AIRCRAFT AT HIGH ANGLES OF ATTACK**

**Odilon V. Cavazos, Jr. - Lieutenant, United States Navy
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Master of Science in Aeronautical Engineering - June 1990

**Advisors: S. K. Hebbar and M. F. Platzer -
Department of Aeronautics and Astronautics**

A water tunnel flow visualization investigation was performed into the high angle of attack aerodynamics of a 2% scale model of the F/A-18 fighter aircraft. The main focus of this study was the effect of pitch rate on the development and bursting of vortices generated from the leading edge extensions in the high angle of attack range with and without yaw. Results of this investigation indicate that the vortex bursting point (relative to the static case) moves rearward with increasing pitch-up motion and forward with increasing pitch-down motion. For the same pitch rate, vortex bursting was found to occur earlier for the pitch-down motion than for the pitch-up motion, implying aerodynamic hysteresis effects. Yawing the model generated significant vortex asymmetries due to the delayed vortex bursting on the leeward side for yaw angles of less than 10°. The presence of these asymmetric vortices led to undesirable forces and yawing moments.

AERODYNAMIC COEFFICIENTS OF A SYMMETRICAL AIRFOIL IN AN OSCILLATING FLOW

**George A. Chamberlain, Jr. - Lieutenant, United States Navy
B.S., United States Naval Academy, 1982**

Master of Science in Aeronautical Engineering - September 1990

Advisor: J. A. Miller - Department of Aeronautical Engineering

A symmetrical airfoil at fixed angle of attack from 0 to 35 degrees was placed in an air flow with controlled velocity oscillations at 10 Hz. The instantaneous pressure distribution and flow velocity were measured simultaneously. Pressure information was integrated numerically to determine instantaneous values for lift, drag and moment about the quarter chord. The results were plotted as three-dimensional surface plots in angle of attack, cycle time and performance coefficient axes, or with chordwise position, cycle time and pressure coefficient axes, as appropriate. The pressure distribution over the airfoil was shown to be primarily a function of freestream static pressure. Aerodynamic coefficients as a function of angle of attack and time exhibited seemingly random, erratic behavior, whereas the mean values of the same coefficients were similar in nature to those obtained in steady flow. The data indicate that the instantaneous performance of an airfoil in an oscillating flow is not merely a continuum of many quasi-steady states.

DEVELOPMENT OF AN UNMANNED AIR RESEARCH VEHICLE FOR SUPERMANEUVERABILITY STUDIES

**Christopher Mark Cleaver - Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1977**

Master of Science in Aeronautical Engineering - March 1990

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

With the advent of all-aspect missiles and highly maneuverable threat aircraft, maintaining air superiority in the future will require innovative solutions to current aerodynamic and propulsive limitations. Unmanned Air Vehicles (UAV's) provide an excellent experimental alternative for supermaneuverability investigations, providing dynamic flight measurements not available in wind tunnels. A 1/8 geometrically scaled F-16A was constructed and test flown in order to provide a proven, highly maneuverable, airframe for control configuration modifications. The aircraft was configured for the measurement of airspeed, angle of attack, sideslip angle, and control surface deflection. A seven-channel telemetry system was designed to transmit the flight measurement data to a ground station for display and recording. Follow-on research will complete the on-board systems and perform a baseline evaluation for comparison with future flight tests with varied control configurations.

NUMERICAL STUDIES OF COMPRESSIBLE FLOW OVER A DOUBLE DELTA WING

**Raymond L. Coutley - Lieutenant, United States Navy
B.S., Marquette University, 1978**

**Masters of Science in Aeronautical Engineering & Aeronautical
Engineer - March 1990**

Advisor: M. F. Platzer - Department of Aeronautical Engineering

The objective of this work is the investigation of vortical flows at high angles of attack using numerical techniques. First step for a successful application of a numerical technique, such as finite difference or finite volume, is the generation of computation mesh which can capture adequately and accurately the important physics of the flow. Therefore, the first part of this work deals with the grid generation over a double-delta wing is defined algebraically. The developed surface grid generator provides flexibility in disturbing the surface points along the axial and circumferential directions. The hyperbolic grid generation method is chosen for the field grid generation and both cylindrical and spherical grids are constructed. The computed low speed ($M = 0.2$) flow results at different angles of attack over the double-delta wing are visualized. Important flow characteristics of the leeward side flow field are discussed while the development of vortex interaction, occurrence and progression of vortex interaction, occurrence and progression of vortex breakdown as the angle of attack increases is demonstrated. The computed results at different fixed angles of attack are presented.

**DESIGN AND CONSTRUCTION OF A
COMPOSITE AIRFRAME FOR UAV RESEARCH**

**Jeffrey L. Ellwood - Lieutenant Commander, United States Navy
B.S., Penn State University**

Master of Science in Aeronautical Engineering - June 1990

Advisor: R. M. Howard - Department of Aeronautical Engineering

A half-scale Unmanned Air Vehicle (UAV) was designed and constructed from composite materials for the Flight Research Lab at the Naval Postgraduate School. The vehicle was designed as a technology demonstrator for two studies. First, for the Tilted Ducted Fan (TDF) vertical flight capability engine and its stability and control system; and second, for the tail configuration testing for Longitudinal and Lateral-Directional stability enhancement of an existing tailless Unmanned Air Vehicle. Completion of these research and test objectives should provide the configuration requirements for a full-scale development vehicle with vertical takeoff and landing with transition to forward flight.

**AN INVESTIGATION INTO THE EFFECTS OF VERMICULITE ON NO_x REDUCTION
AND ADDITIVES ON SOOTING AND EXHAUST INFRARED SIGNATURE FROM A
GAS TURBINE COMBUSTOR**

**Kurt R. Engel - Lieutenant Commander, United States Navy
B.S., U.S. Merchant Marine Academy, 1978**

Master of Science in Aeronautical Engineering - September 1990

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

An experimental investigation was conducted to determine the feasibility of using catalytic reduction of NO_x emissions from a typical jet engine combustor in the test cell environment. A modified T-63 combustor in combination with an instrumented 21 foot augmentation tube containing a vermiculite catalyst was used. Several methods for containing the vermiculite were attempted. Both vermiculite and vermiculite which had been coated with thiourea were used. Up to 19% reduction in NO_x concentrations was obtained using the vermiculite coated with thiourea, however the pressure loss across the catalyst bed was measured to be 36 in. H₂O. The techniques used proved ineffective and unacceptable for gas turbine engine test cell applications. Tests were conducted using both Wynn's W-15/590 and Catane TM (ferrocene) fuel supplements in order to determine their effectiveness for soot reduction and whether or not the exhaust plume could be changed. For the test conditions utilized, the Wynn's additive was not effective in reducing the opacity of the exhaust plume nor for reducing the exhaust plume temperature. The Catane TM reduced the opacity by 6.2%, but also had no significant effect on the plume IR signature.

**STATISTICAL CHARACTERIZATION OF GRAPHITE FIBER FOR
PREDICTION OF COMPOSITE STRUCTURE RELIABILITY**

**Carl Robert Engelbert - Lieutenant Commander, United States Navy
B.B.A., University of Wisconsin, 1974**

Master of Science in Aeronautical Engineering - June 1990

Advisor: E. M. Wu - Department of Astronautics and Aeronautics

The use of composite materials in Navy applications brings with it the need to know quantitatively the reliability of composite structures. Traditional methods of reliability prediction cannot be used. Therefore, analytical modeling is required, and experimental data with which to assess the model are needed. This research refined experimental methods and obtained benchmark statistical data on graphite fibers. With the Chain-of-Bundles local load sharing model, the data were then used as a guide to perform a parametric influence study on the sensitivity of composite structure reliability to the statistical distribution of its constituent graphite fibers. The results indicate a strong influence by the lower tail of the single fiber statistical distribution, which has important implications for design, acceptance testing, and other Navy procurement functions.

**NUMERICAL INVESTIGATION OF THE EFFECT OF LEADING EDGE GEOMETRY
ON DYNAMIC STALL OF AIRFOILS**

Steven P. Grohsmeyer - Lieutenant Colonel, United States Marine Corps
B.S., Illinois Benedictine College, 1973
Master of Science in Aeronautical Engineer and Aeronautical
Engineering - September 1990
Advisors: J. A. Ekaterinaris & M. F. Platzler - Department of
Aeronautics and Astronautics

The dynamic stall of rapidly pitching and oscillating airfoils is investigated by the numerical solution of the full compressible unsteady two-dimensional Navier-Stokes equations using an alternating-direction-implicit scheme. The flow is assumed to be fully turbulent, and the turbulent stresses are modelled by the Baldwin-Lomax eddy viscosity model. Three airfoils (NACA 0012, NACA 0012-33, and NACA 0012-63) are analyzed for the purpose of examining the influence of leading-edge geometry on unsteady flow separation. It is found that a larger leading edge radius, thicker contouring of the forward part of the airfoil, or increasing reduced frequency results in delaying flow separation and formation of the dynamic stall vortex to a higher angle of attack, yielding higher peak C_l . Within the scope of this study, the pressure gradient encountered by the flow at initial separation is found to be independent of reduced frequency and freestream speed. The critical pressure gradient is dependent on leading edge radius and increases for decreasing leading edge radius.

ABLATIVE HEAT SHIELD STUDIES FOR NASA MARS/EARTH RETURN ENTRY VEHICLES

Michael K. Hamm - Lieutenant, United States Navy
B.A., University of Colorado, Boulder, 1980
Master of Science in Aeronautical Engineering - September 1990
Advisor: W. D. Henline - NASA Ames Research Center Thermal
Protection Branch

The research performed in this thesis is to determine the ablative behavior of ceramic Reusable Surface Insulation (RSI) materials in a hypersonic high enthalpy flow that is used to simulate entry into Earth atmosphere. Actual arc jet experiments were performed to measure mass loss, melt run off, and fiber collapse of these materials and compare the experimental results with predicted theoretical values. The tests were performed to ascertain if RSI type materials could be used for entry vehicles proposed in NASA Mars missions.

F-18 ROBUST CONTROL DESIGN USING H_2 AND H_∞ METHODS

Gerald Alan Hartley - Civilian, Naval Weapons Center
B.A.A.E., Ohio State University, 1964
M.S., Denver University, 1971
Master of Science in Aeronautical Engineering - September 1990
Advisor: D. L. Collins - Department of Aeronautics

The open loop F-18 longitudinal control system is stabilized using H_2 and H_∞ singular value loop shaping for a multivariable feedback control system. The H_2 and H_∞ control theories involve suppressing the sensitivity return difference matrix transfer function at the lower frequencies for high gain performance and suppressing the transmissivity at higher frequencies, i.e. loop shaping. The singular value Bode plot is used for MIMO systems in analogy with the classical Bode frequency analysis for SISO systems. There are two control inputs with input 1 controlling the stabilator and input 2 controlling the leading edge flap and trailing edge flap in tandem. There are two outputs: angle of attack and pitch rate. The H_∞ design achieved a separation in that input 1 controlled angle of attack and input 2 controlled pitch rate. The first design is an optimum design which imposed no limitations on control input. A cost penalty associated with control actuator limitations is imposed to achieve a limited performance design.

GROUND VIBRATION CHARACTERIZATION OF A MISSILE SYSTEM FOR A FLUTTER ENERGY DEFINITION

John Barry Hollyer - Lieutenant Commander, United States Navy

B.S., United States Naval Academy, 1978

Master of Science in Aeronautical Engineering - June 1990

Advisor: E. M. Wu - Department of Aeronautics and Astronautics

Changing world scenarios and mission requirements have generated the need to retrofit an all aspect defensive missile system to Patrol airplanes. To this end the AIM-9 Sidewinder was selected and installed on a P-3 at the Naval Air Test Center for envelope expansion and separation tests. The added mass and pitch inertia of this system on the outer wing may combine with the outer wing characteristics to cause catastrophic flutter. A ground vibration analysis was set up to experimentally measure and analytically model the modal characteristics of the stand alone weapon assembly. This weapon system modal characterization can be analyzed in conjunction with the original bare wing dynamic model leading to an assessment of the flight envelope and a safe in-flight flutter test. The facility and methodologies established in this investigation can also be used to characterize other candidate missile systems. This will provide timely fleet relevant results and generate expected cost savings of over 200K dollars.

ANALYSIS AND SYNTHESIS OF RADIATIVE HEAT TRANSFER IN LONGITUDINAL FINS IN FREE SPACE AND NON-FREE SPACE

Dennis R. Johnson - Lieutenant Commander, United States Navy

B.S., North Carolina State University, 1975

Master of Science in Astronautical Engineering - June 1990

Advisor: A. D. Kraus - Department of Electrical and Computer Engineering

The objective of this thesis is to develop an interactive computer program that will analyze and synthesize radiative heat transfer in longitudinal fins. The analysis procedure determines the amount of heat transferred from the given fin given the fin base temperature, fin dimensions and thermal properties. The synthesis procedure is the converse problem: it determines the size of the fin required to dissipate a specified amount of heat given the thermal characteristics of the fin. In addition, the program is capable of performing the analysis/synthesis of three fin profiles (rectangular, trapezoidal, and triangular) in two environments (free space and non-free space). Free space is considered as the absence of external heat sources or interception of the heat dissipated by the fin whereas non-free space includes the effect of external heat sources and neighboring structures. A theoretical analysis of heat transfer from radiating longitudinal fins will be presented along with a user oriented computer program. Finally, detailed examples will be provided to illustrate the different types of problems profiles, and environments.

ANALYSIS OF A PERTURBATION SOLUTION OF THE MAIN PROBLEM IN ARTIFICIAL SATELLITE THEORY

Scott David Krambeck - Lieutenant, United States Navy

B.S., Iowa State University, 1982

Master of Science in Aeronautical Engineering and Astronautical &

Astronautical Engineer - September 1990

Advisor: D. A. Danielson - Department of Mathematics

The development of a universal solution of the main problem in artificial satellite theory has only recently been accomplished with the aid of high powered computers. The solution to this long standing problem is an analytical expression that is similar in form to the two-body solution. An analysis is presented in which the solution is compared with the two-body solution, a proven numerical solution, and actual measured satellite data. The solution is shown to be significantly more accurate than the two-body solution. The theoretical accuracy of the solution is confirmed. The solution compares extremely well with a proven numerical solution of at least 41 orbits with a relative error on the order of 10^{-2} . The solution compares extremely well with measured satellite data for satellites in near Earth orbits. For a satellite in orbit at an altitude of approximately 1000 kilometers, the solution reduces the error of the two-body solution by about 95%. For satellites in orbit at semisynchronous and geosynchronous altitudes, the solution reduces the error of the two-body solution by at least 50%. The solution is free of singularities and is valid for all eccentricities and inclinations.

**WATER TUNNEL FLOW VISUALIZATION STUDIES OF A CANARD-CONFIGURED
X-31A-LIKE FIGHTER AIRCRAFT MODEL**

Hui Man Kwon - Major, Republic of Korea, Air Force

B.S., Air Force Academy, Seoul, 1981

Master of Science in Aeronautical Engineering - September 1990

Advisor: S. K. Hebbar - Department of Aeronautical Engineering

A water tunnel flow visualization investigation was performed to study the vortex development and bursting phenomena on a 2.3% scale model of a X-31A-like fighter aircraft. The main focus of this study was two-fold: (i) to determine the optimum canard location that produces favorable aerodynamic interference on the main wing and (ii) to determine the effect of pitch rate on the optimum-configured model during simple pitch-up and simple pitch-down maneuvers. It was found that a close-coupled canard configuration resulted in a more favorable interference between the vortex systems of the canard and the wing. The dynamic tests indicated that the location of the wing root vortex burst point relative to the static case moved downstream with increasing pitch rate.

DEVELOPMENT OF A 1/7TH SCALE FIGHTER UAV FOR FLIGHT RESEARCH

Daniel M. Lee - Lieutenant, United States Navy

B.S., United States Naval Academy, 1982

Master of Science in Aeronautical Engineering - September 1990

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

A program was initiated to develop a radio-controlled fighter aircraft to be used for supermaneuverability and agility flight research. High angle-of-attack flight testing is a high-risk and very expensive endeavor in manned aircraft, and wind tunnel testing to duplicate dynamic maneuvers is extremely difficult. Another means to conduct agility flight research in a low-cost, low-risk environment has been sought. Construction of a scaled generic Navy fighter model, to be powered by ducted-fan engines and controlled by radio command, was begun. Also, it was deemed essential to incorporate an emergency recovery system in the aircraft, should control be lost due to radio component failure, primary flight system malfunction, or departure from controlled flight. A parachute recovery system was designed, constructed, and tested for structural integrity, opening shock dampening, rapid deployment, and desired rate of descent. Work will continue, leading to flight testing of forebody modifications for enhanced control at high angles of attack.

**IMPACT OF ION PROPULSION ON PERFORMANCE, DESIGN, TESTING
AND OPERATION OF A GEOSYNCHRONOUS SPACECRAFT**

Spotrizano Descanzo Lugtu - Lieutenant, United States Navy

B.S., FEATI University, 1975

Master of Science in Aeronautical Engineering - June 1990

Advisor: B. N. Agrawal - Department of Aeronautical and Astronautical Engineering

This thesis presents the implementation issues of an ion propulsion subsystem on geosynchronous communications satellites. As an example, Ultra-High Frequency (UHF) Follow-On class satellite is selected for this study. The issues include: 1) impact of integration of ion propulsion subsystem with other subsystems, such as the electrical power subsystem to take care of the heavy demand of power requirements and location of the subsystem with least impact on attitude control and plume impingement on solar arrays, 2) environmental considerations- particulate contamination, electrostatic discharge (ESD), and electromagnetic interference (EMI), and finally 3) risks and benefits. Ion propulsion offers significant advantages over chemical propulsion due to its high specific impulse and the advent of xenon thruster technology, multikilowatt spacecraft and nickel-hydrogen (Ni-H₂) batteries with demonstrated high cycle life have combined to make the ion thruster attractive for North-South Station Keeping (NSSK).

**PARAMETER IDENTIFICATION STUDIES ON THE NASA/AMES RESEARCH
CENTER ADVANCED CONCEPTS FLIGHT SIMULATOR**

**Thomas P. McKavitt, Jr. - Lieutenant, United States Navy
B.S., United States Naval Academy, 1983
M.S., Naval Postgraduate School, 1990
Aeronautical and Astronautical Engineer - September 1990
Advisor: L. V. Schmidt - Department of Aeronautics and
Astronautics**

The results of an aircraft parameter identification study conducted on the National Aeronautics and Space Administration/Ames Research Center Advanced Concepts FLight Simulator (ACFS) in conjunction with the Navy-NASA Joint Institute of Aeronautics are given. The ACFS is a commercial airline simulator with a design based on future technology. The simulator is used as a laboratory for human factors research and engineering as applied to the commercial airline industry. Parametric areas examined were engine pressure ratio (EPR), optimum long range cruise Mach number, flap reference speed, and critical take-off speeds. Results were compared with corresponding parameters of the Boeing 757 and 767 aircraft. This comparison identified two areas where improvements can be made: 1) low maximum lift coefficients (on the order of 20%-25% less than those of a 757); and 2) low optimum cruise Mach numbers. Recommendations were made to investigate certain software logic criteria in order to improve ACFS performance levels to those anticipated with the application of future technologies. Results of this study are applicable to future ACFS upgrades including a flight management system. These results are also tabulated for inclusion in the ACFS Performance Manual.

**THE EFFECTS OF LIQUID PROPELLANT MOTION ON THE ATTITUDE
STABILITY OF SPIN STABILIZED SPACECRAFT**

**Jack Walter Myers, Jr. - Major, United States Army
B.S., United States Military Academy, 1976
Master of Science in Astronautical Engineering - March 1990
Advisor: B. N. Agrawal - Department of Aeronautics and Astronautics**

An analysis of the effects of liquid motion on the attitude stability of spin stabilized spacecraft is presented. The effects of varying the fuel load and the asymmetry of the platform are emphasized. The energy sink stability criteria are derived and applied to a marginally stable spacecraft. The stability predictions based on the energy sink stability criteria are compared to the results of a computer simulation. Based on this comparison the limitations of the energy sink stability criteria are identified.

THE USE OF NEURAL NETWORKS IN ADAPTIVE CONTROL

**Donald L. Nedresky - Aeronautical Engineer, Naval Air Test Center
B.S., Indiana University of Pennsylvania, 1980
M.S., University of Southern California, 1985
Master of Science in Aeronautical Engineering - September 1990
Advisor: D. J. Collins - Department of Aeronautics and Astronautics**

An adaptive control system is a system that detects changes in the plant parameters and makes necessary adjustments to the systems performance. This thesis examines the use of parallel distributed processing systems (neural networks) in adaptive control. A general neural network structure is introduced and a description of the Backpropagation paradigm is given. A discussion of adaptive control theory including the one step ahead prediction control algorithm and the linear least squares estimation is given. A neural network structure consistent with adaptive control theory is developed and tested by simulating the lateral and directional motion of the A-4 aircraft. The network output is then compared to the output of the true system. The purpose of this thesis is to develop and test a neural network structure capable of performing the parameter estimation and control functions of an adaptive controller.

**A STUDY OF THE AIRWAKE AERODYNAMICS OVER THE FLIGHT DECK OF
AN AOR MODEL SHIP**

Mark M. Rhoades - Lieutenant, United States Navy

B.S., University of Michigan, 1983

Master of Science in Aeronautical Engineering - September 1990

Advisor: J. Val Healey - Department of Aeronautics and Astronautics

This study investigated the airwake of an AOR Class model ship to provide basic flow pattern and velocity information to aid in solving the elusive problem of blade strikes experienced by H-46 helicopters when they engage or disengage rotors aboard AOR ships. This investigation used the NPS flow visualization tunnel modified to simulate the atmospheric boundary layer. A detailed visualization was completed of the airflow near the flight deck area of a four-foot model in a stationary mode, utilizing helium bubbles, smoke, photographic and video equipment. The results show that the airwake is usually made up of two regions, one that is relatively smooth and one that is extremely turbulent. The dividing line is a shear layer that is created from the air flowing around the port face of the hangar. Another feature found both in the flow visualization, as well as the velocity measurements, was the presence of a significant upward component of flow over the port edge of the flight deck. It was found that this flow had nearly the same speed as the velocity measured at the ship's anemometer position but was inclined at an angle of between 15° and 25°. This upward flow, combined with the highly variable recirculations over the flight deck could be a significant contributing factor in the occurrence of blade strikes. In addition, some attempts were made to eliminate some of the more unruly flow patterns by using curved deflectors. These attempts had some success but will require further study.

**FURTHER CALCULATIONS OF THE PERFORMANCE OF TURBOFAN ENGINES
INCORPORATING A WAVE ROTOR**

James W. Roberts - Lieutenant, United States Navy

B.S., United States Naval Academy, 1981

Master of Science in Aeronautical Engineering - September 1990

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

Two recent computer programs, WRCOMP and ENGINE, by A. Mathur, were used to examine the performance to be gained by incorporating a wave rotor component in a turbofan engine with mixed exhausts. The programs were transferred to a VAX-2000 computer, extended, and test cases reported by A. Mathur were successfully reproduced. A comparison was made between ENGINE, in which real gas effects are accounted for, and ONX (by J. Mattingly) in which constant specific heats are used. The inclusion of real gas effects proved to have a significant impact on the predicted performance. An extension of Mathur's results was made by varying the overall pressure ratio in the wave-turbofan engine. Further cycle studies and experiments to measure wave rotor component performance are recommended.

DEVELOPMENTAL FLIGHT TESTING OF A HALF SCALE UNMANNED AIR VEHICLE

James Dale Salmons - Lieutenant, United States Navy

B.S., Texas A&M University, 1982

Master of Science in Aeronautical Engineering - September 1990

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

Developmental flight test of a half scale unmanned air vehicle was conducted for the purpose of predicting the longitudinal and lateral-directional behavior of the full scale vehicle. Instrumentation was developed and installed in the radio controlled aircraft. The instrumentation allowed for the measurement and recording of control surface movement, indicated airspeed, sideslip angle and angle of attack. The measurement system operated successfully; the data recording system suffered limitations due to the vibration introduced into the airframe by the propeller and engine. Lateral-directional data were obtained from steady sideslip maneuvers, but longitudinal data taken for trimmed flights with varied center-of-gravity positions were unusable. The data were compared to available full scale information. Further flight tests are required to build a larger data base to estimate the behavior of the full scale Pioneer.

**ESTABLISHMENT OF A REMOTELY PILOTED HELICOPTER TEST
FLIGHT PROGRAM FOR HIGHER HARMONIC CONTROL RESEARCH**

James G. Scott - Lieutenant, United States Navy

B.S., The Pennsylvania State University, 1982

Master of Aeronautical Engineering - June 1990

Advisor: E. R. Wood - Department of Aeronautics and Astronautics

The Department of Aeronautics and Astronautics at the Naval Postgraduate School (NPS) has begun analytical research of a helicopter vibration reduction concept known as higher harmonic control (HHC). To supplement this research, a helicopter flight test program has been established to generate flight test data in support of the NPS HHC research efforts. To accomplish this task, a remotely piloted helicopter (RPH) has been chosen as the test vehicle. The research efforts encompassed by this thesis are the determination of attributes required of a RPH used for HHC studies, the selection and acquisition of an RPH capable of completing the intended research mission, and the preliminary analysis of the RPH's flight control system for modification to an HHC configuration. A brief overview of helicopter vibrations and HHC fundamentals, along with an in-depth description of the selected RPH, is presented. The preliminary analysis of the RPH's flight control system included the determination of associated freeplay and torsional constant values for the flight control components and the calculation of the necessary actuator torque requirements for HHC actuation. The research efforts is the first stage of a long term program designed to provide NPS with an inhouse asset capable of generating HHC flight test data in support of analytical research.

**DYNAMIC ANALYSIS OF THE LOW POWER ATMOSPHERIC
COMPENSATION EXPERIMENT (LACE) SPACECRAFT**

Wesley F. Walters - Major, United States Army

B.S., United States Military Academy, 1977

Master of Science in Aeronautical Engineering and

Aeronautical Engineer - June 1990

Advisor: R. Kolar - Department of Aeronautics and Astronautics

The Low Power Atmospheric Compensation Experiment (LACE) spacecraft was launched for NRL in February 1990. The LACE flight dynamics experiment will provide on-orbit system identification of the LACE spacecraft. The experiment is designed to measure modal frequencies, damping ratios, and oscillation amplitudes of the LACE spacecraft. The purpose of this study is to develop a finite element model of the LACE spacecraft and conduct a dynamics analysis to determine natural frequencies and mode shapes. Four configurations of the spacecraft are analyzed. This data will be compared actual orbital data and will provide an opportunity for improvements in the accuracy of computer simulations of flexible structures and multi-body dynamics. Thermoelastic effects due to differential heating are addressed to check the magnitude of deformations that may cause a problem for stability or on-orbit identification. The final phase of this study is to conduct a parametric analysis of the spacecraft boom to investigate the presence of chaotic vibration for combinations of excitation amplitude and frequency.

ATTITUDE CONTROL OF FLEXIBLE STRUCTURES

Christina C. Ward - Lieutenant, United States Navy

B.A., Nasson College, 1978

Master of Astronautical Engineering - September 1990

**Advisor: B. Agrawal - Department of Aeronautical and
Astronautical Engineering**

The experimental set-up for laboratory study of spacecraft control/structural interaction has been designed. Design specifications have been derived, and all the actuators and sensors have been selected except the endpoint displacement sensing of the arm. The mainbody and the flexible arm have been fabricated to meet design criteria. The equations of motion for the experimental model have been derived and natural frequencies determined. The natural frequencies of the flexible arm have been determined experimentally and compared with analytical predictions obtained by using the GIFTS finite element analysis program. The experimental and analytical results are in good agreement except the first mode.

**INITIAL DESIGN STUDY OF EXISTING FLIGHT CONTROL SYSTEM OF RPH AND
FEASIBILITY STUDY OF IMPLEMENTING HHC ON THE SH-60B**

Charles David Webb - Lieutenant, United States Navy

B.S., The Citadel, 1983

Master of Science in Aeronautical Engineering - September 1990

Advisor: E. R. Wood - Department of Aeronautics and Astronautics

The paper reports on two subjects, first the initial design study of a Remotely Piloted Helicopter's flight control system and secondly a feasibility study of implementing Higher Harmonic Control on the SH-60B aircraft. Described for the former is a complete study of stiffness constants, system freeplays and power requirements needed to provide Higher Harmonic Control to the Remotely Piloted Helicopter. The later gives practical design considerations for four alternate mechanical/hydraulic designs. The Remotely Piloted Helicopter Higher Harmonic Control work is an ongoing project at the Naval Postgraduate School and the SH-60B work is a initial study which is currently being evaluated at the Naval Air Test Center.

**THE EFFECTS OF FOREBODY STRAKES ON ASYMMETRIC VORTICES ON A
VERTICALLY LAUNCHED MISSILE**

Chih-Chung Yuan - Lieutenant, Republic of China Navy

B.S., Chinese Naval Academy, 1986

Master of Science in Aeronautical Engineering - September 1990

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

Wind tunnel tests were conducted on a vertically launched surface-to-air missile model to investigate the effects of forebody strakes on the side forces and yawing moments induced by nose-generated asymmetric vortices at high angles of attack. The effects of body configuration and a turbulent flowfield on the induced side forces and yawing moments were also examined. Test angles of attack ranged from 0° to 90° at a Reynolds number of 1.15×10^5 based on the model diameter, and at a Mach number of 0.11. Three forebody configurations, two body configurations and two flowfield conditions were investigated. The flowfield with a turbulence length scale on the order of the vortex scale was found to have no significant influence on the induced side forces and yawing moments. The change of body configuration had no strong effects on the side forces and yawing moments either. The "4 STRAKES" forebody demonstrated dramatic results in the yawing moment alleviation; the ranges of angle of attack in the induced side forces and yawing moments were also decreased by this modification. The "8 STRAKES" forebody gave no significant improvement in the induced side force and yawing moment reduction.

**MASTER OF SCIENCE
IN
APPLIED
MATHEMATICS**

USER INTERFACE TO AN ICAI SYSTEM THAT TEACHES DISCRETE MATH

Keith Calcote - Lieutenant, United States Navy

B.S., Texas Tech, 1983

and

Richard A. Howard - Captain, United States Army

B.S., United States Military Academy, 1982

Master of Science in Applied Mathematics

Master of Science in Computer Science - June 1990

Advisors: K. A. S. Hefner - Department of Mathematics &

M. Shing - Department of Computer Science

The main thrust of this thesis is the design of usable Intelligent Computer Aided Instruction (ICAI) user interface that does not require a natural language processor and runs on a personal computer. Discrete Mathematics is the knowledge domain for this project and the Discrete Math Tutor (DMT) is the name of the tutoring system. The DMT will allow the average student to benefit from a tutoring system now and not have to wait until the artificial intelligence researchers solve the natural language interface problem.

A GENERALIZATION OF SNELL'S LAW

Michael L. Hawkins - Captain, United States Marine Corps

B.S., United States Naval Academy, 1979

Master of Science in Applied Mathematics - June 1990

Advisor: M. Ghandehari - Department of Mathematics

Geometric and variational techniques, along with the method of Lagrange multipliers, optimal control theory, and elementary calculus are the tools used to derive some generalizations of Snell's Law. The focus is both on Snell's Law of Refractions and, on the reflection principle under various conditions.

EXAMINING A SUBPROBLEM OF THE FREQUENCY ASSIGNMENT PROBLEM USING A CONFLICT GRAPH

Donald W. Hintze - Captain, United States Marine Corps

B.S. United States Naval Academy, 1982

Master of Science in Applied Mathematics - March 1990

Advisor: K. A. S. Hefner - Department of Mathematics

There are many problems associated with communication networks. One of the more familiar ones is the frequency assignment problem. Many approaches and techniques have been used in the past in an attempt to solve this problem. This thesis examines a subproblem of the frequency assignment problem, which aids the decision-maker in placing additional links in a network, once a frequency assignment is found. Given a conflict graph for a communications network, the problem involves finding the maximum number of arcs in the corresponding digraph. This digraph is a worst case model for the actual network and will show which additional links may be added to the network in order to enhance communication capabilities. An algorithm was developed to help solve this problem after lower and upper bounds were established for its optimal solution. The algorithm obtains a solution which falls within the bounds and achieves the bounds in special cases.

GUIDE TO DEVELOP A REFRESHER FOR MA1117, SINGLE VARIABLE CALCULUS

Matthew Lampugnano - Captain, United States Marine Corps

B.S., United States Naval Academy, 1980

Master of Science in Mathematics - June 1990

Advisor: G. E. Latta - Department of Mathematics

Refreshers for introductory courses have a variety of useful purposes. They may be used as a tool for newly arriving students to assist in their return to an academic environment, as a review for tests, or as a prelude to what a course offers. They may also be sent to interested personnel in the field. The primary benefit of the refresher is to experience faster learning and greater retention of the material covered. This thesis is a step by step instruction of how to develop a microcomputer based refresher for any subject. These refreshers, in the form of series of questions and answers, are easy to develop as well as easy to use. A Zenith-248 microcomputer or compatible is the main tool used to develop the refresher. An initial file, written on a word processor containing the questions and answers, is the raw data. By following a few simple instructions when creating this file, it can be transformed into a refresher in a minimal amount of time. A refresher for MA1117, single variable calculus, is developed as an example.

COMPARE AT SEA POSITION USING MINI-RANGER, LORAN C (INTERNAV) IN THE CONTEXT OF MEASURING CURRENT VELOCITY WITH A SHIPBOARD ADCP (ACOUSTIC DOPPLER CURRENT PROFILER)

Ioannis S. Moschovos - Lieutenant, Hellenic Navy

B.S., Hellenic Naval Academy, 1979

Master of Science in Hydrography Science and Applied Mathematics

December 1989

Advisor: C. A. Collins - Department of Oceanography

The scope of this thesis is to evaluate the use of the MINI RANGER, LORAN (TD) and LORAN (DISPLAY) navigation systems in order to support the collection of current profiles by an Acoustic Doppler Current Profiler Recorder (ADCP). A theoretical error analysis of these systems is undertaken in order to establish the minimum error limits which might be expected when averaging current profiles over time frames of up to 30 minutes. Experimental data was collected with all of these systems in the Monterey Bay and was analysed, the results being presented in this thesis. In addition GPS data was also collected but time has prohibited its analysis and subsequent inclusion. The results show that because of ship Fluctuations in course and speed there is no statistically significant difference between the navigation systems when we average the data over times of about 25 - 30 minutes. However, they also show that both the MINI RANGER and Bottom Tracking with the ADCP can produce reasonable results in as little as three minutes, although the ADCP results are clearly biased.

A PERTURBATION SOLUTION OF THE MAIN PROBLEM IN ARTIFICIAL SATELLITE THEORY

Christopher Patrick Sagovac - Lieutenant, United States Navy

B.A., Cornell University, 1984

Master of Science in Applied Mathematics - June 1990

Advisor: D. A. Danielson - Department of Mathematics

The main problem of artificial satellite theory is a restricted two body problem in which the Legendre Polynomial representation of the cylindrically symmetric potential contains only the first two terms. A generalized asymptotic expansion is used to obtain a first order approximation. The solution at the critical inclination is seen to be of a different type than at other inclinations. The solution is finite for all eccentricities and inclinations when suitably restricted in time.

AN INVESTIGATION OF THE EXPROB ALGORITHM

Frank Edward Valente - Lieutenant, United States Navy

B.S., United States Naval Academy

Master of Science in Applied Science - March 1990

**Advisors: R. N. Forrest & J. N. Eagle - Department of
Operations Research**

This thesis is an analysis of the use of the EXPROB algorithm in the Antisubmarine Warfare Tactical Decision Aid (ASWTDA). EXPROB is described in ASWTDA documentation as the average value of the instantaneous probability of detection over a region. In order to undertake the analysis, a computer program was written that implemented the EXPROB algorithm. In addition, a second computer program was written that implemented an alternative algorithm that is based on a bivariate normal target distribution. This algorithm provided one reference for the analysis of EXPROB.

**MASTER OF SCIENCE
IN
COMPUTER
SCIENCE**

**AN EMPIRICAL STUDY OF THE FAULT-PREDICTIVE
ABILITY OF SOFTWARE CONTROL-STRUCTURE METRICS**
Alberto Teixeira Bigotte de Aldeida - Lieutenant, Portuguese Navy
Master of Science in Computer Science - June 1990
Advisor: T. J. Shimeall - Department of Computer Science

The increasing cost and complexity of software in recent years is causing a growing interest in the development of measurement technology to evaluate, predict and compare software complexity. Metrics can be used throughout all the development cycle providing valuable information to the software developers in order to enhance the final products. The goal of this thesis is to verify empirically the fault-predictive ability of some software complexity metrics and specifically their usefulness during the testing phase. A set of eight programs, varying in length from 1,186 to 2,489 lines of pascal code with 157 faults identified with specific modules, provided the data for this study. The results of the analysis of the programs using four metrics, cyclomatic complexity, bandwidth, nested complexity and number of statements, show that control-structure metrics can be effectively used to detect the more fault-prone modules. The nested complexity of the modules seems to have some relation with the number of faults caused by wrong use of variable and overrestrictive input checks. These observations can be particularly useful during the testing phase because testers can use control-structure metrics to predict not only the modules that may cause more problems, but also the more frequent types of faults and use the metrics to guide the choice of testing techniques.

**THE INSTRUMENTATION OF A PARALLEL AND SCALABLE DATABASE COMPUTER-
-THE MULTI-BACKEND DATABASE COMPUTER, FOR
BENCHMARKING ITS COMPLEX OPERATIONS**
Darrell W. Alston - Captain, United States Army
B.S., South Carolina State College, 1980
Master of Science in Computer Science - December 1989
Advisor: D. K. Hsiao - Department of Computer Science

This study is the continuation of a performance evaluation technique known as benchmarking to an experimental database management system known as the Multi-Backend Database System (MBDS). The main emphasis of this thesis is on the instrumentation of this parallel and scalable database computer, for benchmarking its complex operations: UPDATE and RETRIEVE-COMMON. The primary research question is to determine whether MBDS demonstrates the response-time reduction and response-time invariance claims when carrying out its two complex operations. In order to benchmark these transactions, the proper instrumentation of the test database, test transaction sets, and test procedures were thoroughly executed. Detailed testing, problem identification (debugging), and minor software modifications were also conducted in an attempt to verify the correctness of the program code for the update and retrieve-common operations. Major problem areas are documented, and proposed solutions are presented to aid future efforts in the evaluation, modification, and testing of these extremely complex operations to ensure their successful performance evaluation.

FUNCTIONAL SPECIFICATION FOR A GENERIC C3I WORKSTATION

Steven E. Anderson

B.A., Trinity College, 1984

Master of Science in Computer Science - September 1990

Advisor: L. Luqi - Department of Computer Science

As fiscal impacts continue to make the U.S. Navy's budget increasingly austere, diligent efforts are being made to enhance the Navy's warfighting capability and streamline its operations. In this environment, it is necessary to efficiently produce computer systems that meet fleet requirements and do so at minimal cost. This thesis illustrates a methodology that integrates rapid prototyping with formal requirements analysis of a Generic C3I Workstation. Traditional requirements analysis and software engineering principles tend to misplace emphasis on the completeness and the comprehensiveness of initial software modeling. Using formal specification tools and techniques, rapid prototyping provides prototype developers with constraints, while deliberately omitting up-front detailed descriptions. Precise constraints are refined through the evolution of requirements in the light of empirical performance, and demonstrable functionality in the field. A network-capable software system for a Generic C3I Workstation, with embedded decision-support systems and robust message passing and processing, would offer functionality beyond that which is traditionally used in fleet operations. Through automation advancements, C3I information processing could be performed more quickly, efficiently and accurately. In this thesis, an abstract model of a high-speed, networkable, generic C3I workstation is presented. This model defines the fundamental goals for the experimental modeling and development of a large, hard-real-time Ada software system for the U.S. Navy.

DESIGN AND IMPLEMENTATION OF THE PMS MODULE FOR 'ARGOS'

Dionis Antonopoulos - Lieutenant, Hellenic Navy

B.A., Greek Naval Academy, 1979

and

Henry V. Turner - Lieutenant, United States Navy

B.S., University of Washington, 1982

Master of Science in Computer Science - December 1989

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

Argos is a prototype multimedia database, developed as a Battle Group Commander's assessment tool and a shipboard data management tool. The ultimate goal of Argos is to provide database support for the "Paperless Ship" Navy. This thesis furthers research on Argos by analyzing, designing, and implementing a fully workable Planned Maintenance System (PMS). This implementation demonstrates both the capabilities and benefits such a system would have for the Navy.

TURBO PASCAL IMPLEMENTATION OF A DISTRIBUTED PROCESSING NETWORK OF MS-DOS MICROCOMPUTERS CONNECTED IN A MASTER-SLAVE CONFIGURATION

Nelson C. Ard

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Master of Science in Computer Science - December 1989

Advisor: U. R. Kodres - Department of Computer Science

This thesis describes the design and implementation of a distributed processing network of IBM PC compatible computers capable of performing parallel processing tasks. The network is a star cluster local area network, with the central computer controlling the operations of the satellite computers on a sequential basis. The local area network software operates over the computer's standard RS-232C communications ports, and is currently implemented to allow the central computer to operate two satellite computers. Processing tasks are dispatched to the satellite computers as programs which run to completion on the satellite computers. Utility programs within the software include file and message transfer to start the programs on the satellite computers and to obtain the output of the remotely executed program, configuration utilities to set the communications port parameters, and windowing utilities for display of information normally presented on the remote computer's display. The program is implemented in Turbo Pascal 4.0 under the MS-DOS operating system, version 3.21.

REFAB: A PROTOTYPE GRAPHICAL FRONTEND FOR THE RESA NAVAL WARGAME

**Thomas G. Avey - Captain, United States Marine Corps
B.S., University of Utah**

Master of Science in Computer Science - June 1990

Advisors: J. N. Eagle & J. M. Yurchak-Department of Computer Science

Computer wargame simulations have typically provided military officers with an effective method of testing their knowledge of tactics and strategy. However, large simulations typically use a command language dialogue interfacing the user with the wargame. This type of interface requires a great deal of typing skill and memorization of the language syntax and allows little time for decision making and battle analysis. RESA is a typical theater-level naval wargame which utilizes this type of interface. Presented in this research is the RESA Enhanced FORCE and BUILD (REFAB), a first phase prototype development of a graphic user interface utilizing a bit-mapped display and windowing environment. REFAB was developed from an existing system, BATMAN and ROBIN. The interface concentrates on combinations of form filling, graphic, direct manipulation, and iconic dialogues, and stresses information presentation. This interface could be utilized for RESA to ease the system operating requirements placed on the RESA users, allowing the user to make timely decisions, gather information quickly, and provide a more rewarding wargaming session.

A DESIGN OF COMPUTER AIDED INSTRUCTIONS (CAI) FOR UNDIRECTED GRAPHS IN THE DISCRETE MATH TUTORIAL (DMT)

**Atilla Bakan - LTJG Turkish Navy
B.S., Turkish Naval Academy, 1984
and**

**Yavuz Bas - LTJG Turkish Navy
B.S., Turkish Naval Academy, 1984**

Master of Science in Computer Science - June 1990

Advisors: M. Shing - Department of Computer Science & A. Hefner - Department of Mathematics

The objective of this thesis research is to create a tutorial for teaching aspects of "undirected graphs" in discrete math. It is one of the submodules of the Discrete Math Tutorial (DMT), which is a Computer Aided Instructional (CIA) tool for teaching math to the Naval Academy and the Westpoint Military Academy students. In order to accomplish the objective, an exploration of various conventional CAI techniques is necessary to determine which methods are readily adaptable for use with the PCs. Many of the design issues normally associated with the development of CAI packages are exasperated by the current physical limitations of the PC based systems. With proper design and appropriate trade-offs, however, effective CAI packages for the PCs are possible. The software designed for this thesis is only an example of the possibilities made available by the PCs.

IMPLEMENTATION OF AN EFFICIENT ALGORITHM TO DETECT MAXIMAL CLIQUES IN A CONFLICT GRAPH

**Kristi Jo Bell - Captain, United States Army
B.S., United States Military Academy, 1982**

Master of Science in Computer Science - June 1990

Advisor: K. A. S. Hefner - Department of Mathematics

In military operations, radio-frequency communications play an important role in command and control. Since the breadth of control may be limited by frequency and channel constraints, research continues to search for better ways to optimize the frequency allocation. In this thesis, graphs are used to model radio-communications networks. The problems considered is the detection of maximal cliques, representing subnets, from the graph model. However, detection of cliques in an NP-complete problem. Since NP-complete problems are not likely to be solvable in a reasonable time if the input is large, this paper limits the network input to six stations and fifteen transmissions. An algorithm is implemented in Pascal to detect all maximal cliques of a network and is known as the program CLIQUE. The program is designed to accept arbitrary connected graphs without being affected by isomorphisms and without generating duplicates. This thesis describes a limited solution to the clique problem and solves a subproblem of the communications frequency problem in real-time.

THE IDENTIFICATION OF SOFTWARE FAILURE REGIONS

John Manning Bolchoz - Major, United States Army

B.S., United States Military Academy, 1978

Master of Science in Computer Science - June 1990

Advisor: T. Shimeall - Department of Computer Science

In these days of spiralling software costs and the proliferation of computers, software testing during development is now recognized as a critical aspect of the software engineering process, an aspect that must be improved in terms of cost and timeliness. This thesis describes one method that may guide software testing by analyzing the regions of input associated with each fault as it is detected. These software failure regions are defined and a method of failure region analysis is described in detail. The thesis describes how this analysis may be used to detect non-obviously redundant test cases. A preliminary examination of the manual analysis method is performed with a set of programs from a prior reliability experiment. Based on faults discovered during the previous experiment, this thesis defines the reachability conditions, the error generation conditions, and the conditions in which an error is not masked by later processing. The manual analysis of failure regions can be a difficult process, with difficulty dependent on program size, program complexity, and the size of the input data space. Program constructs and events that simplify the analysis process are also described. The thesis explains variable contamination and the effects of vertical and horizontal contamination. The thesis also describes the indirect benefits of performing failure region analysis. Finally, there are several open questions raised by this research, and these questions are presented as ideas for future research.

USER INTERFACE TO AN ICAI SYSTEM THAT TEACHES DISCRETE MATH

Keith Calcote - Lieutenant, United States Navy

B.S., Texas Tech, 1983

and

Richard A. Howard - Captain, United States Army

B.S., United States Military Academy, 1982

Master of Science in Applied Mathematics

Master of Science in Computer Science - June 1990

Advisors: K. A. S. Hefner - Department of Mathematics &

M. Shing - Department of Computer Science

The main thrust of this thesis is the design of usable Intelligent Computer Aided Instruction (ICAI) user interface that does not require a natural language processor and runs on a personal computer. Discrete Mathematics is the knowledge domain for this project and the Discrete Math Tutor (DMT) is the name of the tutoring system. The DMT will allow the average student to benefit from a tutoring system now and not have to wait until the artificial intelligence researchers solve the natural language interface problem.

AN INTELLIGENT TUTOR SYSTEM FOR VISUAL AIRCRAFT RECOGNITION

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B.S., Florida Southern College, 1984

Master of Science in Computer Science - June 1990

Advisor: Y.-J. Lee - Department of Computer Science

Visual aircraft recognition (VACR) is a critical skill for U.S. Army Short Range Air Defense (SHORAD) soldiers. It is the most reliable means of identifying aircraft however, VACR skills are not easy to teach or learn, and once learned they are highly degradable. The numerous training aids that exist to help units train soldiers require qualified instructors who are not always available. Also, the varying degrees of proficiency among soldiers make group training less than ideal. In an attempt to alleviate the problems in most VACR training programs, an intelligent tutor system has been developed to teach VACR in accordance with the Wings, Engine, Fuselage, Tail (WEFT) cognitive model. The Aircraft Recognition Tutor is a graphics based, object oriented instructional program that teaches, reviews, and tests VACR skills at a level appropriate to the student. The tutor adaptively coaches the student from the novice level, through the intermediate level, to the expert level. The tutor was provided to two U.S. Army Air Defense Battalions for testing and evaluation. The six month implementation, testing, and evaluation process demonstrated that, using existing technology in Computer Science and Artificial Intelligence, useful training tools could be developed quickly and inexpensively for deployment on existing computers in the field.

AN OPTIMAL STATIC SCHEDULING ALGORITHM FOR HARD REAL-TIME SYSTEMS SPECIFIED IN A PROTOTYPING LANGUAGE

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B.S., Instituto Tecnológico de Aeronautica, 1978

Master of Science in Computer Science - December 1989

Advisor: L. Luqi - Department of Computer Science

The Computer Aided Prototyping System (CAPS) and the Prototype System Description Language (PSDL) are tools that have been designed to aid in rapid prototyping. Within the framework of CAPS the Execution Support System (ESS) controls the execution of the prototype. The Static Scheduler is the component of the ESS which extracts and realizes critical timing constraints and precedence constraints for operators. The construction of a Static Scheduling Algorithm provides the foundation for handling hard real-time constraints during the execution of PSDL. The proposed work will be based on the theories of optimal sequencing through modular decomposition, as well as enumeration techniques. An optimal algorithm will provide the analyst with a definitive method for determining whether a given design can meet its hard real-time requirements.

EQUIPMENT READINESS CODES EXPERT SYSTEM USING JOSHUA FOR U.S. ARMY COMBAT DEVELOPMENT

Thomas E. Chamberlin - Captain, United States Army

B.S., Virginia Polytechnic Institute and State University

Master of Science in Computer Science - June 1990

Advisor: S.-H. Kwak - Department of Computer Science

Expert systems have arrived as a popular productivity tool in business, industrial, and managerial environments. Such tools should be extensively employed into the U.S. Army environments as well. In this thesis, an example of an expert system and its interface is presented. The expert system created enables a U.S. Army Combat Development analyst to utilize expert system technology. The advantages achieved are maintaining consistent and maintaining consistent and accurate Army Combat Development policy, reduction of tedious, analytical tasks to the power of the machine, and the centralization of expert system maintenance and rule production. Furthermore, this expert system provides the much needed but *scarce* expertise to ensure qualitative performance from nonexperts, provides efficiency and consistency of the experts, and even furnishes training for others who need to understand the expert's thought process.

A SPECIFICATION AND ANALYSIS OF THE IEEE TOKEN BUS PROTOCOL

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B.B.A., University of Texas, 1985

Master of Science in Computer Science - June 1990

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

In this thesis a formal description technique, *systems of communicating machines*, is used to specify and analyze a token bus protocol. A simplified description of the protocol is given, and proofs of certain correctness properties presented. The analysis proves that the protocol is free from deadlocks and nonexecutable transitions, and also that successful message transfer is guaranteed for a network with an arbitrary number of machines. A program written in an object oriented language, C++, demonstrates that the description technique, the specification, and the analysis of the protocol is complete and accurate for a network of three stations. The specification is then extended to allow the transmission of different types of messages, errors in the communication channel, acknowledgements from the receiver, and timeouts.

MOVING PLATFORM SIMULATOR III: AN ENHANCED HIGH-PERFORMANCE REAL-TIME GRAPHICS SIMULATOR WITH MULTIPLE RESOLUTION DISPLAY AND LIGHTING

Curtis Paul Cheeseman - Captain, United States Army

B.S., United States Military Academy, 1980

Master of Science in Computer Science - June 1990

Advisor: M. J. Zyda - Department of Computer Science

This study is a continuation of previous work conducted in the development of low cost real-time Moving Platform Simulators using three-dimensional digital terrain elevation data and a high-performance Silicon Graphic, Inc., IRIS 4D/120GX graphics workstation. Most notably this effort combines work conducted on previous models to develop a single comprehensive simulator that demonstrates the most desirable features of those models. Integrated in the development of this simulator is the ability to display high-resolution terrain in multiple interval resolutions using either polygon or mesh drawing algorithms. In addition to the simulator's capability to display the special high-resolution terrain data provided by the United States Army Test and Experimentation Command (USATEC) it also supports Defense Mapping Agency (DMA) Level 1 Digital Elevation Data (DTED). Further work was performed enhancing user interfaces and visual displays. This paper describes the simulator, Moving Platform Simulator III (MPS III), listing its enhancements and features.

SPECIFICATION OF MIL-STANDARD 1553 BUS PROTOCOL AND APPLICATION TO EA-6B COMMUNICATIONS COUNTERMEASURES

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B.A., Linfield College, 1977

Master of Science in Computer Science - December 1989

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

A model for the specification and analysis of communication protocols called *Systems of Communicating Machines* is used to describe and analyze a simplified version of the Mil-Standard 1553 bus protocol. The protocol is used in the EA-6B aircraft for digital communication between aircraft subsystems. The model uses a combination of finite state machines, variables and predicate action tables in the specification of the Bus Controller and Remote Terminals. The enabling predicates determine when a transition may be taken on the finite state machine and actions alter variable values as transitions occur. Normal, error-free 1553 bus command/response information transfers are modeled. The 1553 Mil-Standard does not contain an equivalent specification using a formally-defined model. Practical application to the EA-6B Prowler is focused upon the requirements for transparent integration of the AN/ASQ-191 Radio Countermeasures Set into the existing aircraft bus architecture. Transparent integration into the tactical jamming system of the aircraft would make the ASQ-191 receiver and jamming operations an integral part of aircraft operation and employment, and permit integrated pre-mission planning with TEAMS.

GUIDANCE AND CONTROL SYSTEM FOR AN AUTONOMOUS VEHICLE

**Michael John Cloutier - Lieutenant, United States Navy
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Master of Science in Computer Science - June 1990

Advisor: Y.-J. Lee - Department of Computer Science

The Naval Postgraduate School (NPS) is currently involved in a long-term project to investigate and develop real-time control software, artificial intelligence, computer architecture and control systems theory as they pertain to U.S. Navy autonomous vehicle programs. In support of this goal, the NPS is currently designing and fabricating a testbed autonomous underwater vehicle. This work describes the design, development, and testing of a Guidance Subsystem for this testbed vessel which utilized portions of cubic spirals as the desired path to follow between waypoints. In addition, data translation firmware and real-time control software for the control surfaces and main motors is designed, implemented and tested. The process of selecting and implementing an appropriate computer architecture in support of these goals is also discussed and detailed, along with the choice of associated computer hardware and real-time operating software.

A MODEL FOR MERGING DIFFERENT VERSIONS OF A PSDL PROGRAM

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Master of Science in Computer Science - June 1990

Advisor: V. Berzins - Department of Computer Science

As hardware complexity increases, software complexity increases, and software systems become less maintainable by manual methods. Automated software development methods, like Rapid Prototyping, have served to increase the maintainability of modern software systems, and increase customer participation in the requirements definition process. This makes software systems more maintainable and increases customer satisfaction with the first version of the system. Still, changes are inevitable. The part of the maintenance problem that automated tools currently do not address, is the automatic propagation of changes through multiple version of the same system. The Prototype System Description Language (PSDL) is a language used for exclusively for designing and executing rapid prototypes. This thesis is directed at developing a model for automatically merging two different version of a PSDL program, providing a method for propagation changes through multiple versions of that program.

SIMPLIFICATION OF OBJECTS RENDERED BY POLYGONAL APPROXIMATION

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Master of Science in Computer Science - December 1989

Advisor: M. J. Zyda - Department of Computer Science

Current technology provides a means to obtain sampled data that digitally describes three-dimensional surfaces and objects. Three-dimensional digitizing cameras can be used to obtain sampled data that maps the surface of three dimensional figures and models. Data obtained from such sources enable accurate renderings of the original surface. However, the digitizing process often provides much more data than is needed to accurately recreate the surface or object. In order to use such data in real-time visual simulators, a significant reduction in the data needed to accurately render the sampled surfaces is required. The techniques presented were developed to drastically reduce the number of data points required to depict an object without sacrificing the detail and accuracy inherent in the digitizing.

DESIGN AND IMPLEMENTATION OF MODULE DRIVER AND OUTPUT ANALYZER GENERATOR

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B.S., Purdue University, 1981

Master of Science in Computer Science - June 1990

Advisor: V. Berzins - Department of Computer Science

This thesis presents the Design and Implementation of a "Module Driver and Output Analyzer Generator" (MDOAG) for Spec functions. The generator translates specifications written in the Spec formal specification language into "Module Driver and Output Analyzers" (MDOA) written in Ada. An MDOA is a testing tool which repeatedly calls the implementation of the function with input values provided by a generator program and reports instances for which the results fail to meet the specification. The classification of test results is carried out by Ada code that is automatically generated from the specification of the component to be tested. The Kodiak Application Generator, a fourth-generation attribute grammar tool, is used to implement the translation.

SHORT RANGE AIR DEFENSE PLANNER

Roger Steven Dixon - Captain, United States Army

B.S., University of Tennessee at Knoxville, 1981

Master of Science in Computer Science - June 1990

Advisor: Y-J. Lee - Department of Computer Science

The Short Range Air Defense (SHORAD) Defense Planner, or SDP, is a prototype defense planning and simulation tool. It is designed to aid and train Army Air Defense Officers in the tasks of (1) planning the air defense for a given static asset, and (2) positioning short range air defense weapon systems in the best possible way. A prototype system has been constructed which allows the Air Defender to position his asset to defend, with the system then performing a heuristic search, and displaying four possible attack routes that could be used by attacking aircraft to reach the map region containing the asset. The user may then position Towed-Vulcan, Stinger, and Chaparral weapon systems where he feels they will provide the best defense of the asset, or request the system to position four Vulcans, four Stinger, or four of each Vulcan and Stinger in defense of the asset. The user can then choose any vehicle that he, or the system, positioned and be able to see a 3D representation of what the gunner in that vehicle would see. He is also able to maneuver that vehicle over the 3D terrain to select the best possible defensive position from the gunner's point of view. Both the Towed-Vulcan, and the Chaparral weapon systems, have been modeled in 3D for use in the SDP prototype system.

A CAPTION-BASED NATURAL LANGUAGE INTERFACE HANDLING DESCRIPTIVE CAPTIONS FOR A MULTIMEDIA DATABASE SYSTEM

John David Dulle - Captain, United States Marine Corps

B.B.A., University of Oklahoma

Master of Science in Computer Science - June 1990

Advisors: V. Y. Lum & N. C. Rowe - Department of Computer Science

This research examined the grammar structure of descriptive English captions on multimedia data. The research was composed of three phases. The first phase was to investigate the grammar structure of example descriptive captions from a variety of subject domains. The second phase was to develop a set of domain-independent binary grammar rules to be used in the Caption-Based Interface (CBI) which is a natural language interface for the Multimedia Database System. The third phase of the research was to implement and test the grammar rules in CBI. The program was implemented in C-Prolog on a Sun SPARC workstation. The testing phase also includes timing and memory comparisons between C-Prolog an interpretive programming language and compiled version of the code using Quintus Prolog. This thesis was able to show that the grammar rules that were developed could correctly identify their intended structures. Another accomplishment of this thesis was to demonstrate that the CBI could parse 25 out of 30 example captions and that it could correctly handle some semantic interpretations of the parsed captions.

A TOOLKIT FOR DESIGNING USER INTERFACES
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B.A., Northwestern University, 1984
Master of Science in Computer Science - March 1990
Advisor: M. J. Zyda - Department of Computer Science

Current methods of developing user interfaces for IRIS workstation application programs are inefficient. In order to help speed the development of complex graphics programs, IRIS workstation users need a toolkit that will assist in the design and implementation of user interfaces for graphics programs. This project presents the preliminary work on an interface generator for the Silicon Graphics, Inc., IRIS workstation. The NPS Interface Builder (NPS IB) is designed to speed the creation of application programs by allowing a user to define an interface graphically rather than by writing "C" code. The program provides on-screen editing, facilitated by a number of program features. NPS IB can be user to develop the basic framework of a graphics program, or can be user to enhance the capabilities of an already existing graphics application.

**EVALUATIONS OF SOME SCHEDULING ALGORITHMS
FOR HARD REAL-TIME SYSTEMS**
Bao-Hua Fan - Commander, R.O.C. Navy
B.S., Chinese Naval Academy, 1977
Master of Science in Computer Science - June 1990
Advisor: V. Berzins - Department of Computer Science

The Computer Aided Prototyping System (CAPS) and the Prototype System Description Language (PSDL) represent a pioneering effort in the field of software development. Execution of the prototype is controlled by an Execution Support System (ESS) within the framework of CAPS. The Static Scheduler is one of the critical elements of the ESS which extracts critical timing constraints and precedence constraints for operators and schedules the time-critical operators to guarantee that their timing constraints will be met. The Static Scheduler used the information of timing constraints and precedence constraints to determine whether a feasible schedule can be built. This construction provides the foundation for handling the execution for hard real-time systems. The goal of this thesis is to provide improved versions of the Static Scheduler.

**RAPID PROTOTYPING: A SURVEY AND EVALUATION OF METHODOLOGIES
AND MODELS**
Harrison Douglas Fountain - Captain, United States Army
B.S., San Francisco State University, 1981
Master of Science in Computer Science - March 1990
Advisor: L. Luqi - Department of Computer Science

The DoD requirements for software are growing almost as rapidly as the escalating cost of developing the software. The new rapid prototyping paradigm is an innovative approach to software development, which modifies the traditional life cycle model. This thesis features a comprehensive survey and evaluation of the rapid prototyping paradigm. The survey describes the rapid prototyping process, the complex prototyping support system environment required, proposed rapid prototyping methodologies, and published rapid prototyping models. The rapid prototyping methodologies and models are evaluated with respect to their conceptual design. The survey and evaluation of the methodologies and models reveal a progressive paradigm featuring some methodologies and models that can be implemented now and some that are capable of being implemented in the future. Because of DoD's influence on the software industry, we discuss how DoD should usher in the new paradigm, set strategic goals, and further decompose these goals into near-term, short-term, and long-term goals.

SOLVING THE WEIGHTED REGION LEAST COST PATH PROBLEM USING TRANSPUTERS

Ivan Garcia - Captain, United States Marine Corps

B.S., University of New Mexico, 1982

Master of Science in Computer Science - December 1989

Advisor: M. T. Shing - Department of Computer Science

The weighted region least cost path problem involves finding the minimal cost path between a source point and a goal point through a plane that has been subdivided into weighted regions. In this thesis, we investigate a new parallel approach which seeks to take advantage of the distributed, asynchronous computing environment provided by INMOS Transputer. The algorithm consists of a family of local, asynchronous, iterative and parallel procedures. The program is implemented on a network of transputers using a parallel version of the C programming language and tested on various maps of triangulated weighted regions. Results were favorable in terms of producing a near optimum path and reduced processing time.

THE WEST POINT DATABASE CONVERSION PROJECT - FROM A NETWORK TO A RELATIONAL DBMS

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and

Georgette P. Wilson - Captain, United States Army

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Master of Science in Computer Science - June 1990

Advisor: V. Y. Lum - Department of Computer Science

In this thesis, we propose a relational database design based on the information which the United States Military Academy is required to maintain, the frequency of use of this information, as well as current and future applications. Included in the design are an Enhanced Entity Relationship Diagram (reflecting the entities and their relationships to one another), the attributes for each entity and relationship (located in the tables), and the functional dependencies from which the diagram and tables were formed. A prototype, reflecting this design, has been built on the Oracle DBMS, which is expected to be the target system. The source data is derived from a UNISYS-based network DBMS model that is used to support the current application. As a result, a database conversion process will be executed. Relative to the conversion process, we have included considerations for migrating data. These considerations include data validation, maintaining data quality, and a discussion of general versus specific methodologies for data migration. This thesis discusses and shows how the data conversion can actually be accomplished, including the intermediate file format, and a demonstration of how actual queries may be executed on a sample database using the proposed relational design.

A METHODOLOGY FOR HANDLING DATA ERRORS AND INCONSISTENCIES IN DATABASE CONVERSIONS

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Master of Science in Computer Science - June 1990

Advisor: V. Y. Lum - Department of Administrative Science

A database management system (DBMS) can have numerous errors and inconsistencies in its data. Examples of errors and inconsistencies that may be contained in DBMS are: Referential integrity violations, logical inconsistencies, redundancies and out-of-range values. During conversion of database management systems, the errors and inconsistencies in the source system must be corrected so the data entered into the new target DBMS will be accurate. The goal of this thesis is to examine a source database management system to determine what errors and inconsistencies are possible, to propose a methodology to detect them, and to correct such errors and inconsistencies prior to entering the data into the target DBMS. In applying my proposals, the thesis will examine the specific systems utilized by the United States Military Academy (USMA) at West Point, New York. The Academy uses a UNISYS 1100/72 mainframe computer in support of its existing network model DBMS. West Point proposes to convert from its current network model to a relational model system. The thesis will also address the general applicability of this methodology to other database management system conversions.

DERIVATION STRATEGIES FOR EXPERIENCED-BASED TEST ORACLES

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Master of Science in Computer Science - December 1989

Advisor: T. J. Shimeall - Department of Computer Science

Traditionally, large software systems are tested to demonstrate that the system satisfies the set of functional requirements and specifications from which it was derived. Various methodologies exist for conducting this type of testing. However, when the requirements document, or specification, has become outdated or incomplete to the point that they are irrelevant, then testing must take a different approach in order to verify and validate. There can be many reasons why a large software system gets developed without a clear specification; notwithstanding testing must proceed even when confronted with a non-existent specification. Testing in such situations is difficult since there is no separation of specified function from implemented function, and thus no objective standard for judging the correctness of test results. This research proposes a strategy for verification and validation of large software systems when no effective requirements specification exists. To derive an objective correctness standard, the strategy employs requirements information gained from a variety of sources: user conferences, analyst conferences, new user manuals, inverse transformation of code to specification, a validated "kernel" system, and previous test strategies.

INTERCONNECTION OF THE GRAPHICS LANGUAGE FOR DATABASE SYSTEM TO THE MULTI-LINGUAL, MULTI-MODEL, MULTI-BACKEND DATABASE SYSTEM OVER AN ETHERNET NETWORK

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Master of Science in Computer Science - December 1989

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

In recent years, the proliferation of database models required to meet today's ever changing database needs has led to a variety of Database Management System (DBMS) designs. This situation has presented a challenging problem for database managers. How does one access information from heterogeneous databases without having to learn and utilize the host's database model and language? The answer seems to lie in the area of multi-lingual, multi-model database systems. Such systems allow the user to access data from any database, using any language the user is familiar with, regardless of the model used to create the database. An experimental system has been developed and implemented at the Naval Postgraduate School in Monterey, California. One problem with the current system is the lack of a consistent and user-friendly interface to interact with the system. Many different visual interfaces for databases have been proposed in recent years and one of the most promising is GLAD (Graphics Language for Database). GLAD utilizes direct manipulation of database objects through the use of buttons and other controls. The purpose of this thesis is to enhance the GLAD interface and allow it to transparently communicate with a backend data server, in this case an ISI mini-computer running the Multi-Lingual, Multi-Model, Multi-Backend Database System (MBDS) software, allowing users to access heterogeneous databases in a simple and intuitive manner.

MULTIPROCESSOR SCHEDULING FOR HARD REAL-TIME SOFTWARE

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Master of Science in Computer Science - June 1990

Advisor: L. Luqi - Department of Computer Science

This thesis builds upon work previously done in the development of the Computer Aided Prototyping System (CAPS) and the Prototype System Description Language (PSDL) and presents a conceptual design for the pioneer prototype of the static scheduler for multiprocessors which are part of the CAPS execution support system. The design of hard real-time systems is gaining importance in the software engineering field as real-world processes are becoming automated. This increase in automation needs the advancement of software design technology to meet the design requirements for these hard real-time system. The CAPS and PSDL are tools being developed to aid the software designer in the rapid prototyping of hard real-time systems. Scheduling PSDL operators in multiprocessor systems to meet the timing constraints is the main part of this thesis. Implementation of the conceptual design will be the basis for further work in this area.

**ISSUES IN EXPANDING THE SOFTWARE BASE MANAGEMENT
SYSTEM TO SUPPORT THE COMPUTER AIDED PROTOTYPING SYSTEM**

**James M. Huskins - Major, United States Army
B.S., United States Military Academy, 1977
M.S.E., Catholic University of America, 1987
Master of Science in Computer Science - June 1990
Advisor: L. Luqi - Department of Computer Science**

This thesis proposes reorganizing the Software Base Management System of the Computer Aided Prototyping System (CAPS) to take better advantage of object-oriented database technology, domain analysis and rule based systems. A method for using the Prototyping System Description Language (PSDL) augmented with domain dependent keywords to classify reusable Ada components and organize them in an object-oriented database is presented. A rule based structure needed to implement this software base is also described. Implementation of this structure is the basis for further research.

SOME EFFECTS OF PILOT EMERGENCY TUTORING SYSTEM ON F-4 AIRCRAFT FUEL SYSTEM

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Master of Science in Computer Science - June 1990
Advisor: N. C. Rowe - Department of Computer Science**

This research studies making an intelligent tutoring system to reduce pilot mistakes during an inflight emergency, specifically the flight environment for an F-4 aircraft fuel system malfunction. The pilot emergency tutoring system consists of an expert system with knowledge of the F-4 aircraft fuel system and a tutoring system with strategy to teach students. The expert and tutoring systems use a means-ends analysis problem approach. The mean-ends analysis approach reduces differences between the current state and goal state until the final state or an unsolvable state is reached. Through use of the program, pilots can learn to prevent decision-making errors and procedural errors. Consequently, the pilot can be freer to serve as aircraft commander during an emergency situation.

**DESIGN AND IMPLEMENTATION OF THE ACOUSTIC DATABASE
AND ACOUSTIC TRAINER MODULES FOR "ARGOS"**

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Master of Science in Computer Science - June 1990
Advisor: C. T. Wu - Department of Computer Science**

ARGOS is a multimedia database prototype system currently being developed by the Computer Science Department at the Naval Postgraduate School in Monterey, California. Its primary purpose is to provide a prototype system that could be used as a Battle Group Commander's assessment tool and a shipboard data management tool. In addition to providing increased efficiency and productivity to the Navy, the ARGOS system is designed to assist in the paper reduction effort currently underway on board Navy ships. The purpose of this thesis is to develop an acoustic database and trainer module for the operations module of the ARGOS system. This implementation demonstrates the contribution such a system would make to the efforts of the Anti-submarine warfare (ASW) community.

STATIC SCHEDULERS FOR EMBEDDED REAL-TIME SYSTEMS

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B.S., Turkish Naval Academy, 1983

Master of Science in Computer Science - December 1989

**Advisor: U. R. Kodres - Department of Electrical and
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Because of the need for having efficient scheduling algorithms in large scale real time systems, software engineers put a lot of effort on developing scheduling algorithms with high performance. But algorithms, developed upto now, are not perfect for all cases. At this stage, instead of having one scheduling algorithm in the system, more than one different algorithm which will try to find a feasible solution to the scheduling problem according to the initial properties of tasks would be very useful to reach a high performance scheduling for the system. This report presents the effort to provide static schedulers for the Embedded Real-Time Systems with single processor using Ada programming language. The independent nonpreemptable algorithms used in three static schedulers are run according to the timing constraints and precedence relationships of the critical operators extracted from high level source program. The final schedule guarantees that timing constraints for the critical jobs are met. The primary goal of this report is to support the Computer Aided Rapid Prototyping for Embedded Real-Time Systems so that we determine whether the system, as designed, meets the required timing specifications. Secondary goal is to demonstrate the significance of Ada as the implementation language and a modeling tool for a prototyping system.

AN EFFECTIVE ACCESS CONTROL MECHANISM AND MULTILEVEL SECURITY FOR MULTILEVEL SECURE DATABASE

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B.S., Indiana University of Pennsylvania, 1983

and

Shawn W. Stroud - Captain, United States Marine Corps

B.S., United States Naval Academy, 1982

Master of Science in Computer Science - December 1989

Advisor: D. K. Hsiao - Department of Computer Science

Security mechanisms on contemporary database systems typically inhibit system performance. However, without security, the database system which stores classified data of different classifications, will pass through classified data of different levels in order to find the properly classified data. This 'pass through' inhibits performance (i.e., reduces access precision) because unnecessary material has been retrieved which does not aid in the resolution of the query. Further, the pass-through issue also breaches the security, since the system may pass through higher classified data for the purpose of locating the lower classified one. This thesis shows for the first time, our Query Modification and Multilevel Security approach to database security, implemented into a single database system, i.e., the Multi-Backend, Multi-Lingual, Multi-Model Database System. These security mechanisms, unlike those seen on contemporary database systems, enhance system performance while simultaneously providing a higher degree of security without the pass-through problem.

**PETRI NET AND FAULT TREE ANALYSIS: COMBINING TWO TECHNIQUES FOR
A SOFTWARE SAFETY ANALYSIS ON AN EMBEDDED MILITARY APPLICATION**

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B.S., United States Naval Academy, 1977

Master of Science in Computer Science - December 1989

Advisor: T. J. Shimeall - Department of Computer Science

Software safety ensures that software programs, which control complex systems, perform within certain limits without resulting in an unacceptable risk of an accident occurring. Petri Nets are used to model concurrent computer systems by helping to understand complex interactions and paths of execution. Fault Tree analysis is used to determine safety requirements by detecting software logic errors. They also identify multiple failure sequences in a system that can lead to safety hazards. Petri Nets and Fault Tree analysis can be combined and used in conjunction with each other. They can take advantage of each others inherent strengths. This combined methodology can provide an efficient and effective safety analysis technique. This thesis surveys software safety research and focuses on Petri Nets and Fault Tree analysis. We discuss an extended example combining Petri Nets and Fault Tree analysis. The example is a real-time, military embedded software application. We then indicate directions for further research.

**3-D SHIPS: RAPID 3-D ICON GENERATION FOR THE COMMAND AND
CONTROL WORKSTATION OF THE FUTURE**

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Master of Science in Computer Science - December 1989

Advisor: M. J. Zyda - Department of Computer Science

The Command and Control Workstation of the Future (CCWF) project demonstrated the practicality of implementing a real-time graphics display to provide a modern fleet commander with a realistic visual display of his arena of operations [Ref. 1]. One drawback to that implementation is the limited number of vessel icons incorporated. The primary goal of this study is to provide an interactive tool for the rapid generation of three dimensional ship icons suitable for use in the CCWF. By centering the icon definitions around a standard object file format and providing a program that allows manipulation of these components to construct numerous complete ship icons from a limited base of ship component files, the flexibility of the current CCWF is enhanced.

**DEVELOPMENT OF A HYPER TEXT ORIENTED TECHNICAL INFORMATION
MANAGEMENT SYSTEM**

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B.S., United States Naval Academy, 1984

Master of Science in Computer Science - December 1989

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

Argos is a prototype multi-media database system being developed, utilizing modern off the shelf technology, to produce a new generation of shipboard data management tools. The ultimate goal of the project is to provide database support for the "Paperless Ship" Navy. This work extends Argos' functionality by providing on-line access to technical information, and the tools necessary to conduct key work searches of large volumes of textual information.

**A MISSION PLANNING EXPERT SYSTEM WITH THREE-DIMENSIONAL PATH
OPTIMIZATION FOR THE NPS MODEL 2 AUTONOMOUS UNDERWATER VEHICLE**

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Master of Science in Computer Science - June 1990
Advisor: S.-H. Kwak - Department of Computer Science**

Unmanned vehicle technology has matured significantly over the last two decades. This evidence by its widespread use in industrial and military applications ranging from deep-ocean exploration to anti-submarine warfare. Indeed, the feasibility of short-range, special-purpose exploration to anti-submarine warfare. Indeed, the feasibility of short-range, special-purposes vehicles (whether autonomous or remotely operated) is no longer in question. The research efforts have now begun to shift their focus on development of reliable, longer-range, high-endurance and fully autonomous systems. One of the major underlying technologies required to realize this goal is Artificial Intelligence (AI). The latter offers great potential to endow vehicles with the intelligence needed for full autonomy and extended range capability; this involves the increased application of AI techniques to support mission planning and execution, navigation and contingency planning. This thesis addresses two issues associated with the above goal for Autonomous Underwater Vehicles (AUV's). Firstly, a new approach is proposed for path planning in underwater environments that is capable of dealing with uncharted obstacles and which requires significantly less planning time and computer memory. secondly, it explores the use of expert system technology of AUV missions.

**INTEGRATION OF THE EXECUTION SUPPORT SYSTEM FOR THE COMPUTER-
AIDED PROTOTYPING SYSTEM (CAPS)**

**Frank V. Palazzo
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Master of Science in Computer Science - September 1990
Advisor: L. Luqi - Department of Computer Science**

With the rapidly falling cost of computer hardware continuing to drive software expenses up, attention has turned to ways to effect savings. One approach that shows particular promise is rapid prototyping. Rapid prototyping is the use of executable models of a software system to firm up the requirements before a significant amount of time and effort has been invested in implementation. The computer-aided prototyping system (CAPS) is a rapid prototyping system that automates many of the manual processes of prototyping, thus allowing for quicker prototyping construction and even further cost savings. Within CAPS there exists an execution support system. The purpose of the execution support system is to take the description of a prototype written in the prototyping language PSDL and to convert this into an executable prototype which can then be shown to the user. Previous research resulted in separate implementations for the components of the execution support system, but these components were never integrated into a functioning system. It is the development of this tool which is the subject of this thesis.

**DESIGN AND IMPLEMENTATION OF A MULTIMEDIA DBMS:
RETRIEVAL MANAGEMENT**

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B.S., Royal Thai Naval Academy, 1985**

Master of Science in Computer Science - September 1990

Advisor: V. Y. Lum - Department of Computer Science

Current conventional Database Management Systems (DBMS) manage only alphanumeric data. However, data to be stored in the future is expected to include some multimedia form, such as images, graphics, sounds or signals. The structure and the semantics of the media data and the operations on that data are complex. It is not clear what requirements are needed in a DBMS to manage this kind of data. It is also not clear what is needed in the data model to support this kind of data; nor what the user interface should be for such a system. The goal of the Multimedia Database Management System project in the computer science department of the Naval Post Graduate School is to build into a Database Management System (DBMS) the capability to manage multimedia data, as well as the formatted data, and define operations on multimedia data. This thesis, focusing only on the media data of image and sound, first describes the operations of such a system, then discusses the general design of it, and finally outline the detailed design and implementation of the retrieval operation.

**DESIGNING INTELLIGENT COMPUTER AIDED INSTRUCTIONAL SYSTEMS
WITH INTEGRATED KNOWLEDGE REPRESENTATION SCHEMES**

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B.S., United States Military Academy, 1981**

and

**John P. Tidd - Captain, United States Army
B.S., United States Military Academy, 1981**

Master of Science in Computer Science - June 1990

Advisor: Y.-J. Lee - Department of Computer Science

Over the past 20 years, automated tutoring systems have gained an increasing recognition as a prominent area of Artificial Intelligence (AI). During this period, Intelligent Computer Aided Instruction (ICAI) systems were developed using a variety of AI techniques to enhance the learning process. The core AI issue in designing these systems concerns knowledge representation. A review of current AI literature yields the following conclusions: there are numerous, distinctly different knowledge representation schemes, and most conventional programming environments do not readily support all of these representation schemes. This thesis proposes that tutoring systems are best designed in a programming environment that supports multiple, integrated knowledge representation schemes. Such an environment allows the designer to select and easily employ the most natural knowledge representation scheme for each type of knowledge in the tutoring system. In this thesis, we describe the components of a generalized ICAI system; discuss the various types of knowledge and knowledge representation schemes; and review the knowledge representation schemes used in several noted ICAI systems. In addition, we describe two prototype ICAI system (Map Reading Tutor and Pilot Emergency Procedure Tutor) which we developed in a specific programming environment that support multiple, integrated knowledge representation schemes. We analyzed the behavior of both systems and discussed how the programming environment has facilitated the construction process of the two prototypes and enhanced their overall quality.

OBJECT-ORIENTATED DATABASE MANAGER FOR THE LOW COST COMBAT DIRECTION SYSTEM

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**Master of Science in Computer Science - December 1989
Advisor: M. L. Nelson - Department of Computer Science**

A modern Combat Direction System (CDS) must have the capacity to perform real-time processing of tactical data from more than twenty interfaces. These include multiple tracking sensors, multiple weapons interfaces, electronic warfare, and multiple tactical data link systems. Efficient processing and display requirements in such sophisticated systems have greatly increased the development cost of fielding new systems. The Navy wishes to develop a Low Cost Combat Direction System (LCCDS) which could be installed on non-combatant ships or could augment the processing capability on ships currently equipped with CDS systems. During the initial portion of Increment One of the LCCDS project, a suitable object-oriented database management system (OODBMS) must be chosen to form the basis for the remainder of the project. The goal of this thesis is to determine the feasibility of using a commercially available OODBMS. Evaluation of three systems shows that GemStone, a product of Servio Logic Corporation, Alameda, CA, best fits the requirements of this project.

REQUIREMENTS ANALYSIS FOR A LOW COST COMBAT DIRECTION SYSTEM

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B.S., Rhode Island College, 1976**

and

**Guenter Peter Steinberg - Lieutenant Commander, Federal German Navy
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**Master of Science in Computer Science - June 1990
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The U.S. Navy has recently embarked on a program called Next Generation Computer Resources (NGCR) whose aim is a cooperative effort between Navy and industry to field a set of state-of-the-art computers for shipboard use in the late 1990's. One of the important features of NGCR is the use of commercial hardware developed to a standardized protocol and ruggedized for military applications. This protocol provides for compatibility between machines. The machines themselves may be of any architecture so long as they can meet the protocol requirements as specified by NGCR. The NGCR protocol, while not fully defined, implies the use of microprocessor based workstations. The Naval Sea Systems Command, in an effort to keep pace with combat system software, desires experience in developing software targeted for commercially available NGCR machines (workstations). This study provides a detailed set of initial requirements for such a system. The approach is to implement the basic features of a Combat Direction System (CDS) on a microprocessor based workstation. This low cost CDS (LCCDS) will initially be installed on noncombatant vessels which currently have no computer processing capability at all. Eventually the LCCDS may be used to augment current processing capability of CDS equipped combatants followed by future systems designed around high speed (SAFENET) networks of tactical workstations.

**THE DESIGN OF A DL/I-TO-NETWORK INTERFACE FOR THE MULTI-MODEL,
MULTI-LINGUAL, MULTI-BACKEND DATABASE SYSTEM**

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Master of Science in Computer Science - December 1989
Advisor: D. K. Hsiao - Department of Computer Science**

There has been a tremendous growth in recent years in the use of data base management systems (DBMS) throughout the world. This has lead to efforts to increase the effectiveness and efficiency of systems designed to create and maintain large databases. The traditional approach has been to select a data model and its associated model-based data language and implement a database system based on that single model. The multi-model and multi-lingual database sytem (MM&MLDS) was designed to increase the functionality of database systems by allowing the use of multiple data models and several model-based languages on a single system. With this approach, the system could support a heterogeneous collection of databases, each based on the model most appropriate for the individual application requirements. The current implementation of MM&MLDS is restricted in cross-model accessing the available databases. This thesis is part of the effort to remove these restrictions, thereby allowing the databases. This thesis is part of the effort to remove these restrictions, thereby allowing the databases based on given models to be accessed by database languages associated with different models. The goal of this thesis is to further increase the functionality of MM&MLDS by permitting a user knowledgeable only in a hierarchical-based data language (DL/I) to access and manipulate information in a network database, while strictly maintaining the integrity of the network model. The emphasis is to provide the design analysis necessary to accomplish the translation. More specifically, to develop a process for transforming a network database schema into an equivalent hierarchical schema and to analyze the DL/I requests that are used to access a database and provide a methodology for equivalent access to a network-based database system.

**GRAPHIC INTERFACE FOR ATTRIBUTE-BASED DATA LANGUAGE QUERIES FROM
A PERSONAL COMPUTER TO A MULTI-LINGUAL, MULTI-MODEL, MULTI-
BACKEND DATABASE SYSTEM OVER AN ETHERNET NETWORK**

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Master of Science in Computer Science - December 1989
Advisor: C. T. Wu - Department of Computer Science**

This research is aimed at taking one step closer to the goal of the "paperless ship". This thesis examined the feasibility of providing a visual interface to allow queries from a front end Personal Computer (PC) using the Attribute-Based Data Language (ABDL) to a Multi-lingual, Multi-model, Multi-backend mini-computer, providing an improved Human-Machine Interface for the system will greatly increase its usability. A protoype was implemented in the Graphics LAnguage for Database (GLAD) on a Zenith 248 as the front end connected to a ISI mini-computer running the Multi-Lingual, Multi-Model, Multit-Backend Database System (MBDS), a backend of the future. The Zenith 248 was chosen as the front end because of the large quantity of these computers throughout the Navy. GLAD was used because it is a graphics object-oriented environment for databases that gives the user access to both data manipulation and program development through visual interaction. This creates a user friendly windowing environment both for development and for operational applications. Looking towards the future, MBDS is the perfect backend as it is the latest in Database management systems. This thesis provided an extension to GLAD to demonstrate the ability to send Attribute-Based Data Language to Multi-Backend Database System.

THE INCORPORATION OF CHANGES IN AN EXISTING FLIGHT SCHEDULE

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Master of Science in Computer Science - June 1990

Advisor: N. C. Rowe - Department of Computer Science

This research examined the effectiveness of using computers in making personnel changes to an existing training flight schedule. The program uses heuristics based on the flight regulations provided by Chief, Naval Air Training Command for advanced Strike Flight Training. The program was developed in C-Prolog on an Integrated Solutions, Incorporated (ISI) Optimum V Workstation.

ACCESSING NETWORK DATABASES VIA SQL TRANSACTIONS IN A MULTI-MODEL DATABASE SYSTEM

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and

Alphonso L. Woods - Lieutenant, United States Navy

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Master of Science in Computer Science - December 1989

Advisor: D. K. Hsiao - Department of Computer Science

Traditional approaches to database-system design and implementation involve single-model, single-language database systems with their inherent lack of flexibility and extensibility. An alternative to the traditional approach to database-system design and implementation is the multi-lingual database system (MLDS). This approach allows the user with the user's familiar data language to access and update one or more unfamiliar databases in different data models as if they are in the user's familiar data model. Thus, MLDS has the flexibility and extensibility in database accesses. In this thesis, we present a methodology for the relational user to access and update network databases with a relational data language. Specifically, we designed an interface for allowing the recreational/SQL user to access a network database via SQL transactions. This thesis further extends the functionality of MLDS.

A RULE-BASED SYSTEM FOR SHIPBOARD AIR DEFENSE

Ming-Hua Wang - Lieutenant Commander

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B.S., Chinese Naval Academy, 1979

Master of Science in Computer Science - December 1989

Advisor: Y. J. Lee - Department of Computer Science

This thesis examines the practicality of using an expert system approach in designing an intelligent air defense system to assist the Officer in Tactical Command (OTC) onboard a ship to make efficient and accurate decisions in critical situations in the battlefield. We analyzed modern anti-ship weapons and the counterattack measures. We also formalized some of the decision making processes and designed a computer simulation system. The system receives preprocessed sensor input, determines what contacts are present, performs target analysis and correlation based on current tactical situation, and suggests the best possible actions to take. The simulation results showed that the system can be used to speed decision making and response time in a time-critical combat environment.

THE DEVELOPMENT OF A RAPID PROTOTYPING ENVIRONMENT

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B.S., University of New Mexico, 1984

Master of Science in Computer Science - December 1989

Advisor: L. Luqi - Department of Computer Science

Currently the development and maintenance of DOD embedded software systems with hard real-time constraints is a very complex, time-consuming and costly task. This situation can be improved by the use of adequate development methods and powerful support tools. This thesis explores the development and integration of rapid prototyping tools for the Computer Aided Prototyping System (CAPS). CAPS supports the design and evolution of large, reliable embedded software systems while significantly reducing their associated development and maintenance costs. CAPS utilizes the Prototype System Description Language (PSDL) and an integrated set of construction and analysis tools. The integration of these tools utilizes previous work on their design, with partial implementations and feasibility studies for some of the tools. We have defined and implemented a user interface while testing previous tools, refining the designs of the tools and either refining the implementation or generating the initial implementations. The user interface provides systematic access to the tools of the environment to support the underlying rapid prototyping methodology. Integration issues include system configuration, integration testing, design modifications, implementations, and evolution of previously developed tools within this rapid prototyping environment.

**MASTER OF SCIENCE
IN
ELECTRICAL
ENGINEERING**

**REAL-TIME MULTI-FREQUENCY MODULATION USING
DIFFERENTIALLY-ENCODED SIGNAL CONSTELLATIONS**

Peter G. Basil - Lieutenant, United States Coast Guard

B.S.E.E., United States Coast Guard Academy, 1985

Master of Science in Electrical Engineering - June 1990

Advisor: P. H. Moose - Department of Electrical and Computer Engineering

This report discusses advances in the development of a multi-frequency modulation (MFM) packet communications system on an industry standard computer. Transmitter and receiver programs are described that control vector signal processors and data acquisition devices. Further, these programs encode, modulate, demodulate, and decode the MFM signal. The throughput data rate was doubled, the encoding/decoding process was implemented in near real-time, and a personal computer plug-in board was designed and built to provide synchronization between the transmitter and receiver. This MFM implementation provided acceptable bit error rates at input signal-to-noise ratios of 15 dB and above.

**DESIGN OF A SENSOR-BLENDING KALMAN FILTER FOR THE R2P2 FINE-
TRACKING SYSTEM**

Terrance J. Bauer - Captain, United States Army

B.S., United States Military Academy, West Point, New York, 1981

Master of Science in Electrical Engineering - March 1990

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

The performance of a sensor-blending scheme for two different bandwidth sensors is significantly improved when a Kalman filter is used to blend the outputs vice classical control methods. This Kalman filter signal blender is designed and implemented in a computer program developed for this thesis. Several tracking scenarios are simulated and analyzed. These scenarios are representative of the input expected into the sensors on a Space Based Laser.

MEASUREMENT OF THE CAPTURE EFFECT OF FREQUENCY MODULATION

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B.S., United States Naval Academy, 1983

Master of Science in Electrical Engineering - December 1989

Advisor: G. A. Myers - Department of Electrical and Computer Engineering

Capture Effect is a phenomenon associated with frequency modulation (FM). The capture effect relates the ability of the receiver demodulator to recover the message of the dominant carrier when two or more FM carriers of unequal power level are present. In this research, an experimental system is constructed that generates the sum of two FM signals and demodulates that sum using a phase-locked loop (PLL). The effect on capture by several parameters is measured. These parameters are the frequency deviation of the FM signal, the frequency of the message, and the lowpass filter design of the PLL demodulator. Capture ratios as small as 0.387 dB are observed. Results show that the frequency deviation of the stronger signal affects capture. The frequency deviation of the weaker signal has no effect on capture. Frequencies of the messages have small effects on capture.

DESIGN OF A STABILIZED, DC-POWERED ANALOG LASER DIODE DRIVER

John J. Bradunas - Major, United States Marine Corps

B.S., Cornell University, 1977

Master of Science in Electrical Engineering - September 1990

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

This thesis presents the design, implementation and evaluation of a dc-powered, stabilized-output laser diode drive unit for use in an analog fiber-optic communication transmitter. The driver circuits provide for a stable temperature-controlled operating environment by monitoring the thermistor in the laser diode module and by controlling the current to the module's integral thermoelectric cooler. Output optical power is maintained at desired bias and peak-to-peak levels by processing the signal from the monitor photodiode and amplifying (if necessary) the ac and dc drive currents. These efforts offset the degradation of the laser diode's capabilities due to heat and age.

ERROR PROBABILITIES OF FREQUENCY-HOP MFSK WITH SELF-NORMALIZATION COMBINING IN A FADING CHANNEL WITH PARTIAL-BAND INTERFERENCE

Michael Wayne Briske - Captain, United States Army

B.S., Rose-Hulman Institute of Technology, 1981

Master of Science of Electrical Engineering & Electrical Engineer - June 1990

Advisor: T. T. Ha - Department of Electrical and Computer Engineering

Research entails derivation statistical description of output from an MFSK receiver which uses self-normalization of the output from quadratic detectors. The system uses fast frequency hopping to provide diversity and assumes independent channels for each hop when the signal is recombined. The effects of fading channels are investigated for both Rayleigh and Rician fading channel descriptions. Probability of bit error for the uncoded performance is plotted for various signal-to-noise ratios (SNR) and different levels of diversity versus worst-case partial-band jamming. Analysis for Forward Error Correction coding is included for rate 1/2 and 1/3 convolutional codes and (n,k) Reed-Solomon Block codes. Probability of bit error is plotted for each code with various signal-to-noise ratios and diversity levels 1 to 4 versus worst-case partial-band jamming.

AN EQUIVALENT RECTANGULAR WAVEGUIDE MODEL FOR FINLINE

Thomas A. Bush - Captain, United States Army

B.S., United States Military Academy, 1978

Master of Science in Electrical Engineering - December 1989

Advisor: J. B. Knorr - Department of Electrical and Computer Engineering

This thesis describes an equivalent rectangular waveguide model for finline. The model is used to predict the wavelength and characteristic impedance of finline based on numerical data generated by the spectral domain analysis technique. A comparison of the voltage-power and voltage-current definitions of characteristic impedance is provided as justification for using this approach. The model is applicable to all finlines with centrally positioned fins, aspect ratio of 2, and dielectric constant of 2.22. Results are provided for $=\{0.01, 0.02, 0.05, 0.10, 0.20, 0.50, 1.00\}$ and dielectric substrate thicknesses of 0 to 30 mils in 5 mil increments. The model is designed so that it can be easily implemented in most of the commercially available microwave CAD software packages.

**DEVELOPMENT AND INTEGRATION OF THE NPS MIDDLE ULTRAVIOLET
SPECTROGRAPH WITH AN EXTREME ULTRAVIOLET SPECTROGRAPH**

Richard S. Campbell - Lieutenant, United States Navy

B.S.E.E., United States Naval Academy, 1980

Master of Science in Electrical Engineering - December 1989

**Co-Advisors: D. Cleary - Department of Physics & S. Michael -
Department of Electrical and Computer Engineering**

Current measurements of ionospheric electron densities are accurate but limited in scope. Present measurement techniques are land-based and the resulting data is not global in nature. Scientists at the Naval Postgraduate School (NPS) and the Naval Research Laboratory (NRL) are working on a joint research project to develop a technique to determine global ionospheric electron densities from satellite platforms. NPS developed a middle ultraviolet spectrograph with wavelength coverage of 1800 to 3400 Å. This thesis developed the integration package that linked the spectrograph analog data to the Aydin Vector MMP-600 PCM Encoder. The integration package provided analog-to-digital conversion of the data, data storage for the digital data, and synchronization of the data collection and data transmission operations. Testing equipment was also developed to support laboratory calibration and in-place testing of the instrument. The test equipment provides computer generated synchronization signals and digital data acquisition.

NEAR-ANGLE SCATTERING AND BINARY OPTICS

Larry Vernon Chizek - Lieutenant, United States Navy

B.T., University of Idaho, 1983

B.S.E.E., Naval Postgraduate School, 1989

Master of Science in Electrical Engineering - December 1989

Advisor: J. R. Neighbours - Department of Physics

The research objective was to measure near-angle scattering (i.e., scattering less than one degree from the specular beam) from a binary optic and determine if a scalar scattering theory could adequately predict scattering performance. Near-angle scattering was measured from a binary optic beam splitter. A scalar scattering theory was developed and modeled using FORTRAN on a personal computer; results from the computer simulation are compared to the actual measurements. The scalar scattering theory modifies Fraunhofer diffraction by including two types of surface topography which contribute to the scattering, specifically: 1) surface roughness due to micro-irregularities which are considered to be randomly distributed and 2) large scale surface features (i.e., the binary step pattern) which are deterministic. The random surface roughness, the autocorrelation length of the roughness, and the height of the binary optic's pattern were determined using a Talystep surface profilometer. The scalar theory appears to give good results when compared to the measurements. However, higher values were required for the surface roughness and autocorrelation lengths than the Talystep indicated, which may be due to the Talystep's short scan length. Military and space applications for binary optics are also discussed.

**COMPUTER-AIDED DESIGN MODELS FOR MILLIMETER-WAVE SUSPENDED-
SUBSTRATE MICROSTRIP LINE**

Man Soo Choi - Lieutenant, Republic of Korea Navy

B.S.E.E., Korean Naval Academy, 1981

Master of Science in Electrical Engineering - March 1990

**Advisor: A. A. Atwater - Department of Electrical and
Computer Engineering**

An equivalent circuit model was derived for the series gap discontinuity in shielded suspended-substrate transmission line. Numerical values of the circuit parameters were computed for various sets of line dimensions, over a range of operating frequencies.

SYSTEM ANALYSIS OF A TACTICAL MULTI-SATELLITE COMMUNICATION SYSTEM

**Thomas M. Clemons, III - Lieutenant, United States Navy
B.S.E.E., United States Naval Academy, 1982
Master of Science in Electrical Engineering and
Electrical Engineer - December 1989
Advisor: T. T. Ha - Department of Electrical and
Computer Engineering**

Initial design study of low altitude satellite (LASAT) communication system is performed. The use of many inexpensive, low-altitude satellites in random orbits may be a solution to vulnerability of current military communication systems. Statistical study of orbit characteristics is performed giving the mean number of satellites in view of a ground station and the coverage density of the satellite array. Waveform analysis is performed on a coded and uncoded, orthogonal, noncoherent, fast-frequency-hopped M-ary frequency-shift-keyed signal in a Rician fading channel with optimum partial band jamming. An analytical expression for the system probability of bit error is obtained and numerical results are generated for various levels of fading jamming and diversity. Forward error correction coding is applied using convolutional codes and Reed-Solomon codes.

DISCRETE ARMA MODEL FOR NATURAL RESONANCES IN ELECTROMAGNETIC AND ACOUSTIC SCATTERING

**Yuval Cohen - Lieutenant Commander, Israeli Navy
B.Sc. in Electrical Engineering, Technion-Israel
Institute of Technology, Haifa, Israel, 1986
Master of Science in Electrical Engineering - September 1990
Advisor: M. A. Morgan - Department of Electrical and Computer Engineering**

Investigations of scattered transient waveforms from conducting bodies have shown that it is possible to classify electromagnetic scatters. The concept is based upon the natural resonance modes which are part of the scatterer response to an incident excitation. A new approach for describing natural resonance modes using recursive systems is introduced. A discrete auto-regressive moving-average (ARMA) type model for the case of the space-time wave equation is presented. This model results from a finite-difference approximation to the wave-equation. The ARMA model has spatially-independent coefficients for the temporal recursive terms. Computed results showing aspect- and spatial-independence of natural resonance modes, with verification of the ARMA model, are also included. Applications to target identification, using the natural resonant frequencies of the target's echo signature, are considered.

POWER RECOVERY OF RADIATION-DAMAGED GALLIUM ARSENIDE AND INDIUM PHOSPHIDE SOLAR CELLS

**Corinne Cyranowski - Lieutenant, United States Navy
B.S., Northern Illinois University
M.S.S.M., University of Southern California
Master of Science in Electrical Engineering - December 1989
Advisor: S. Michael - Department of Electrical and Computer Engineering**

Radiation damaging to on-orbit solar arrays was found to significantly decrease power output and efficiency. By a process of annealing, these cells can recover some of the initial performance parameters. Gallium Arsenide (GaAs) and Indium Phosphide (InP) solar cells were subjected to 1 MeV electron radiation by a Dynamitron linear accelerator at two fluence levels of $1E14$ and $1E15$ electrons/cm². The annealing process was varied by temperature, amount of forward biased current, light conditions and time. Both types of cells were found to be hardened to radiation; however, the InP cells were superior over the two. Multiple cycles of irradiating and annealing were performed to observe the amount of degradation and recovery. The results prove that substantial recovery will occur, particularly with the InP cells. Applying this process to on-orbit spacecraft utilizing solar arrays as the main source of power will significantly increase mission life and potentially decrease cost of the on-board power system.

ANALYSIS OF PERFORMANCE INDICES FOR ALL-POLE, CLOSED-LOOP SYSTEMS

Darrell R. Davis - Captain, United States Army

B.S., United States Military Academy, 1980

Master of Science in Electrical Engineering - March 1990

**Advisor: G. J. Thaler - Department of Electrical and
Computer Engineering**

This study was concerned with the transient performance of servomechanisms. Only those systems with a steady-state-displacement error of zero when subjected to an input-step function were considered. Specific linear and nonlinear systems were optimized by minimizing the cost functionals of the integral of time multiplied by the absolute value of the error and the integral of time multiplied by the absolute value of error plus a weighting factor times the control effort squared. Resultant pole locations were evaluated to determine the existence of progressive and useful patterns. Standard forms were derived for first-through seventh-order systems. Active networks were designed using these standard forms. Step responses were evaluated in terms of the components of the cost functional. Nonlinear and linear optimizations were compared to determine if one was superior to the other. Performance indices were compared to determine if advantages existed for the inclusion of a control cost. Conclusions drawn by previously published material were investigated for validity.

SIMULTANEOUS WIDEBAND TRANSMISSION OF FIVE FDM SIGNALS OVER A FIBER OPTIC LINK

Ilias K. Dimopoulos - Lieutenant, Hellenic Navy

B.S., Hellenic Naval Academy, 1980

Master of Science in Electrical Engineering - December 1989

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

The purpose of this project was the design, construction and testing of a fiber optic communication link for the simultaneous transmission of five audio signals using the technique of frequency division multiplexing. The five subcarrier frequencies were between 1 and 10 MHz. Amplitude modulation with two sidebands and suppressed carrier using an analog voltage multiplier (AD834) was chosen for efficient transmission through the fiber. The unwanted image signals and intermodulation products from the mixing operation were removed using active bandpass filters. An interesting result was the successful design and operation of active filters at the high frequencies using the Generalized Immitance Converter (GIC) configuration. An LED and pin-photodiode pair was used for the optical portion of the link. Simulated link distances of up to 3.2 kilometers were attained using these components. A constant gain for signal frequencies ranging between 200 Hz and 20 kHz was observed during the operation of the system with all the five channels working simultaneously.

DOPPLER PROCESSING OF PHASE ENCODED UNDERWATER ACOUSTIC SIGNALS

Randy Michael Eldred - Lieutenant, United States Navy

B.E.E., University of Delaware, 1983

Master of Science in Electrical Engineering - September 1990

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

Travel time of an acoustic signal from transmitter to receiver provides a great deal of information about the ocean environment. Variations in the travel time of the signal may be caused by the changes in the sound speed along the path. Since sound speed is a function of pressure, temperature, and salinity, measurement of this parameter in acoustic tomography provides a means to observe ocean fluctuations through the use of inverse techniques. The upcoming Heard Island Experiment will attempt to determine the feasibility of measuring global warming by measuring changes in signal travel time that may be caused by temperature changes in the world's oceans. The signals to be transmitted in this experiment are phase encoded maximal-length sequences of various lengths which are well suited to measurement of travel time. The objectives of this thesis are to provide a software package, in C, that will allow participation as a receiver in this experiment, and to provide a general capability to process any maximal-length sequence, transmitted at any carrier frequency and with any reasonable Doppler. A background on wave propagation, maximal-length sequences and Doppler processing are presented in this thesis.

**KU-BAND HIGH POWER AMPLIFIER
SYSTEM FUNCTIONALITY AND OPERATION**

**Cheng-Chuan Feng - Lieutenant, R.O.C. Navy
B.S., Chinese Naval Academy, 1982**

Master of Science in Electrical Engineering - June 1990

Advisor: H.-M. Lee - Department of Electrical and Computer Engineering

The subsystems and their respective functionality of a ku-band high power amplifier are carefully documented. Figures identifying physical components, wiring, contact points, switches and valves with their labels on the system blueprints are presented. These figures will be helpful if system performance parameter adjustments are desired. Operation, maintenance, troubleshooting, and testing procedures are also included to make this thesis a self-contained operator's manual for the high power amplifier.

**THE DESIGN OF A NAVIGATOR FOR A TESTBED AUTONOMOUS
UNDERWATER VEHICLE**

**John Robert Friend - Lieutenant Commander, United States Navy
B.S., University of Virginia, 1976**

Master of Science in Electrical Engineering - December 1989

Advisor: R. Cristi - Department of Electrical and Computer Engineering

Autonomous Underwater Vehicles (AUV) are the subject of study at the Naval Postgraduate School (NPS). This thesis discusses the formulation of a navigator for the Testbed AUV being constructed at NPS. The navigator being proposed estimates the position of the vehicle using measurable dynamic parameters. The estimate is refined by an observation of position using sonar. The effects of set, drift and sonar noise are minimized using a filter. A simulation to test the AUV is also provided to test the effectiveness of the navigator through a range of noise environments. The simulation is an extension of the work of LT Hartley who modeled a more complex sonar to detect motion over the ground for a station keeping AUV.

**INSTRUMENTATION REQUIREMENTS OF TREE EFFECTS DATA COLLECTION
AT THE NAVAL POSTGRADUATE SCHOOL FLASH X-RAY FACILITY**

Dale Galarowicz

**Electrical Engineer, Physics Department, Naval Postgraduate School
B.S.E.E., Naval Postgraduate School, 1988**

Master of Science in Electrical Engineering - June 1990

Advisor: X. K. Maruyama - Department of Physics

The collection of photon-induced transient radiation effects on electronics (TREE) data in a pulsed X-ray facility is hampered by severe electrical noise created by the pulse generation process. This thesis presents suitable techniques for data collection and evaluation when using the Pulserad Model 112A pulsed X-ray generator installed in the Naval Postgraduate School Flash X-ray facility. The TREE of wafer scale integrated devices is of primary concern to researchers at this time; therefore, instrumentation development was based primarily on the needs dictated by these devices. A brief description of the current status of wafer scale integrated devices is presented along with some basic TREE data collected on these devices.

**A STUDY OF PC-BASED HF IONOSPHERIC PROPAGATION
PREDICTIONS FOR USE IN NAVAL COMMUNICATIONS**

**Georgios H. Giakoumakis - Lieutenant J.G., Hellenic Navy
B.S., Hellenic Naval Academy**

Master of Science in Electrical Engineering - June 1990

Advisor: R. W. Adler - Department of Electrical & Computer Engineering

High frequency (HF) ionospheric propagation predictions have been available on mainframe computers since the late 1960s. Since the advent of low cost, computationally powerful personal computer, several propagation codes have been ported from mainframes to PC's. This study compares results from two versions of the IONCAP and PROPHET HF propagation codes to a database of measured electric strengths. IONCAP-PC 2.5 predictions were compared to IONCAP-VAX 85.04 predictions and those from PROPHET 3.2 (PC-version). A database of measured signal strengths from the CCIR containing over 16,000 points or cases was used as a benchmark for comparing code results. For both IONCAP-PC 2.5 and PROPHET 3.2, field strength predictions were low in more than 50% of the cases examined. This was particularly true for PROPHET, which is considered to be a conservative model. PROPHET features quick solutions, graphical output, and a user-friendly environment, in comparison to IONCAP. IONCAP-PC 2.5, which is an improved version of a previous mainframe IONCAP, produced slightly more accurate predictions than IONCAP 85.04, and substantially better results than those from PROPHET.

THE USE OF WINDOW FUNCTIONS AND KALMAN FILTERING IN SPECTRAL ESTIMATION

William W. Go - Captain, United States Marine Corps

B.A., University of Pennsylvania, 1980

Master of Science in Electrical Engineering - March 1990

Advisor: R. Hippenstiel - Department of Electrical and Computer Engineering

The periodogram, the square of the magnitude of the Fourier Transform, is widely used to estimate the spectral content of sampled processes. The performance of the periodogram is degraded by spectral leakage. This is the consequence of processing finite-length data records. Classical means of enhancing periodogram performance are the use of tapered window functions and averaging of several periodograms. These methods smooth the spectral estimate, but at a loss of resolution. A non-stationary Kalman filter was applied to the periodogram of untapered (i.e., rectangular windowed) time data in an effort to smooth the noise portions of the periodogram while leaving the main spectral response unaltered. Even in the case of multiple spectral peaks, the resolution of the unfiltered periodogram was largely preserved since the filtering algorithm was designed to selectively smooth the noise-only segments of the spectral estimate.

**MEASURED NOISE PERFORMANCE OF A DATA CLOCK CIRCUIT DERIVED FROM
THE LOCAL M-SEQUENCE IN DIRECT-SEQUENCE SPREAD SPECTRUM SYSTEMS**

Stuart D. Harshbarger

B.S., West Virginia Institute of Technology, 1985

Master of Science in Electrical Engineering - September 1990

Advisor: G. Myers - Department of Electrical and Computer Engineering

An improved method for deriving the timing information required for data recovery in the receiver of direct-sequence spread spectrum systems was implemented in hardware. This method uses a prior knowledge of the spreading sequence and its relation to the transmitted data to determine the precise beginning and end of data bits in the received signal. Testing of the hardware built for this research is concerned primarily with the performance of the circuit designed to provide the timing required to implement an integrate and dump circuit as a means of data recovery. A conclusion of this research effort is that a method exists for deriving the timing information required for data recovery from the locally generated m-sequence in the receiver. This method appears to be superior to alternative methods since the reference timing is derived from the locally generated m-sequence and is therefore isolated from the effects of additive noise in the channel. In addition to this improvement in noise performance, the new method is independent of transitions in the data stream which permits design flexibility for voltage representation of bits. Further, the timing may be derived from existing hardware that is a part of many direct-sequence spread spectrum communication systems.

DESIGN OF AN INTERACTIVE SATELLITE COMMUNICATIONS SYSTEM ANALYSIS PROGRAM

Charles Craig Howard - Major, United States Army

B.S., United States Military Academy - June 1990

Advisor: D. V. Z. Wadsworth - Department of Electrical & Computer Engineering

This thesis addresses the design of an interactive satellite communications system analysis program. The program provides the capability to analyze/ design a system comprised of two earth terminals and one or two geosynchronous satellites. The principal goal is to simplify the analysis/ design process via a graphically-oriented, *menu-driven computer program*. The program leads the user methodically through the process and provides feedback that enables the user to visualize the elements of the system and their role relative to the other system components. Hypertext concepts are employed in an object-oriented programming environment to achieve the graphics orientation. The success of the program validates the use of innovative software tools to design programs that can enhance user understanding and increase productivity.

DESIGN OF A PIPELINED MULTIPLIER USING A SILICON COMPILER

Ronald Scott Huber - Lieutenant Commander, United States Navy

1, University of California at Riverside, 1976

Master of Science in Electrical Engineering - June 1990

Advisor: H. H. Loomis - Department of Electrical and Computer Engineering

This thesis describes the design methodology and the process of employing the Genesil Silicon Compiler (GSC) (V7.1) in the layout of a pipelined multiplier, in 15. micron CMOS technology, using parallel multiplier cell array. Additionally, background material on the GSC, the theory of multiplication, as well as the concept and theory of pipelining are presented. The results revealed two practical limits of the GSC system which precluded achieving the high component density made possible by full custom, "manual" CAD methods using graphic layout tools. Although the GSC system did not perform as desired in this study, it offers a viable alternative to the labor intensive, full custom, VLSI graphic layout tools in use today.

FUSION OF GROUND-BASED SENSORS FOR OPTIMAL TRACKING OF MILITARY TARGETS

John A. Hucks II - Captain, United States Marine Corps

B.S., Lamar University, 1978

Master of Science in Electrical Engineering - December 1989

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

Extended Kalman filtering is applied as an extension of the Position Location Reporting System (PLRS) to track a moving target in the XY plane. The application uses four sets of observables which correspond to inputs from a fused-sensor array where the sensors employed are acoustic, seismic, or radar. The nonlinearities to the Kalman filter occur through the measured observables which are; bearings to the target only, ranges to the target only, bearings and ranges to the target, and a Doppler-shifted frequency accompanied by the bearing to that frequency. The observables are nonlinear in their relationships to the Cartesian coordinate states of the filter. Filter error covariances are portrayed as error ellipsoids about the latest target estimate made by the filter. Rotation of the ellipsoids is accomplished to avoid the cross correlation of the coordinates. The ellipsoids employed are one standard of deviation in the rotated coordinate system and correspond to a constant of probability of target location about the latest Kalman target estimate. Filtering techniques are evaluated for both stationary and moving observers with arbitrarily moving targets. The objective of creating a user-friendly, personal computer based tracking algorithm is also discussed.

VARIABLE FREQUENCY PULSE WIDTH MODULATION FOR ZERO VOLTAGE SWITCHING IN A BOOST DC-DC REGULATOR

Daniel Scott Hunter - Lieutenant, United States Navy

B.S., Pennsylvania State University, 1982

Master of Science in Electrical Engineering - March 1990

Advisor: G. D. Ewing - Department of Electrical and Computer Engineering

A technique for operating a pulse-width-modulated (PWM) dc-dc regulator in the boost mode while switching the MOSFET when the drain-to-source potential is near zero volts was developed and is described in this thesis. This is accomplished by using frequency-modulation in addition to pulse-width-modulation. Zero-voltage switching will provide power converter designers an alternative for designing high-frequency converters with minimal transient turn-on losses, the predominant form of converter losses experienced in high frequency operation. High frequency operation will result in smaller reactive components, which produce higher power density converters, as well as increasing the transient response of the regulated converter. In addition to allowing for high frequency operation, the design exhibits many desirable power switch properties, such as limiting the peak voltage to the output voltage level and operating with the minimum possible current levels for a given power requirement. A circuit built and tested utilizing zero-voltage switching in a regulated boost converter verified the principles of operation for yielding a high-efficiency, high-frequency converter.

ERROR CONTROL CODING FOR MULTI-FREQUENCY MODULATION

Robert W. Ives - Lieutenant, United States Navy

B.S., U.S. Naval Academy, 1982

Master of Science in Electrical Engineering - June 1990

Advisor: P. H. Moose - Department of Electrical and Computer Engineering

Multi-frequency modulation (MFM) has been developed at NPS using both quadrature-phase-shift-keyed (QPSK) and quadrature-amplitude-modulated (QAM) signals with good bit error performance at reasonable signal-to-noise ratios. Improved performance can be achieved by the introduction of error control coding. This report documents a Fortran simulations of the implementation of error control coding into an MFM communication link with additive white Gaussian noise. Four Reed-Solomon codes were incorporated, two for 16-QAM and two for 32-QAM modulation schemes. The error control codes used were modified from the conventional Reed-Solomon codes in that one information symbol was sacrificed to parity in order to use a simplified decoding algorithm which requires no iteration and enhances error detection capability. Bit error rates as a function of SNR and E_b/N_0 were analyzed, and bit error performance was weighed against reduction in information rate to determine the value of the codes.

ADAPTIVE CONTROL METHODS FOR MECHANICAL MANIPULATORS: A COMPARATIVE STUDY

Hamadi Jamali - LTJG, Marine Royale

B.S., Lycee El Malqui, Rabat, 1980

Ing. Mech., Ecole Royale Navale, Casablanca, 1984

Ing. Mech. Sp., C.I.N., Saint Mandrier, France, 1985

Master of Science in Electrical Engineering - December 1989

Advisor: R. Cristi - Department of Electrical and Computer Engineering

A new adaptive control law for mechanical manipulators that maintains uniformly good performance over a wide range of motions and payloads is developed. This control strategy combines properties from both the Model Reference Adaptive Control and the Self Tuning Regulator Theory and serves to extend the Adaptive Model Following Control approach into using a nonlinear reference model. The design procedure is simple resulting in an overall system which is globally stable and offers itself to microcomputer implementation. The effectiveness of the approach is demonstrated on several computer simulations which compares its performances against some of the commonly known adaptive control techniques. Also presented is a comparison of the computation complexity of different methods used in deriving the dynamic equations of motion of a mechanical manipulator as well as a survey of various robot control methodologies available in the literature today.

EVALUATION OF FERROELECTRIC MATERIALS FOR MEMORY APPLICATIONS

Carl Elof Josefson - Commander, United States Navy

B.S., United States Naval Academy, 1971

Master of Science in Electrical Engineering - June 1990

Advisor: R. P. Panholzer, Chairman - Space Systems Academic Group

The technical literature on ferroelectric materials memory devices was reviewed to evaluate the potential for ferroelectric data storage systems in military applications. This thesis discusses the physical mechanisms and examines the claims made for the technology. The potential roadblocks, such as cycle dependent fatigue, time dependent degradation of memory retention, and fabrication problems are evaluated in terms of the impact on memory devices. This thesis describes the proposed designs and weighs their relative advantages. There are numerous applications for ferroelectric memories as the obstacles to full production are eliminated. A joint NPS/industry space evaluation of engineering prototype devices outlined will provide qualification data for applications requiring radiation tolerance.

AFFINE INVARIANT MATCHING OF NOISY OBJECTS

Chang-Lung Kao - LCDR, Taiwan Republic of China Navy

B.S., Chinese Naval Academy 1980

Master of Science in Electrical Engineering - December 1989

Advisor: C. H. Lee - Department of Electrical and Computer Engineering

In computer vision many techniques have been developed for object recognition. The affine invariant matching algorithm proposed by Hummel and Wolfson (1988) is a new and interesting method. Under affine invariant transformation, objects with translation, rotation, scale changes, and/or even partial occlusion will have the same or similar coefficients. However, some serious problems exist in the original algorithm. This thesis begins with the discussion of the affine transformation. The shortcomings that can occur in this method such as the basis instability, the collision of hash table, and the noise sensitivity will be discussed. Among them the noise sensitivity is a serious problem. This can always cause the recognition procedure to fail. In this thesis an improved affine invariant matching algorithm was developed to overcome the noise problem and other disadvantages of the original algorithm. The area test criteria were adopted to avoid the numerical instability problem. The modified hashing structure using a special hash function was implemented to achieve faster accessing and voting. In the recognition procedure, the partial voting technique with the consideration of false peaks from the voting array highly enhanced the noise tolerance of the algorithm. Finally, the results obtained from the improved algorithm clearly showed better performance than those of the original algorithm.

A STUDY OF THE SENSITIVITY OF THE GREENLAND SEA ACOUSTIC TOMOGRAPHY ARRAY

Chih-Chung Kao - Lieutenant, R.O.C. Navy

B.S., Chung Cheng Institute of Technology, 1982

Master of Science in Engineering Acoustics - December 1989

Advisor: C. S. Chiu - Department of Oceanography

An acoustic tomography array consisting of six transceiver moorings was jointly deployed by Woods Hole Oceanographic Institution and Scripps Institute of Oceanography in the Greenland Sea during the second half of 1988. Two of the primary objectives of this thesis are: (1) to set up and test a stochastic 3-D inversion code for the Greenland Sea Acoustic Tomography data analysis; and (2) to evaluate the performance of the acoustic system through resolution and variance analyses. In acoustic tomography, the sound speed perturbation field is estimated from measured acoustic travel time perturbation data. A unique sound speed perturbation estimate can be constructed using the Gauss-Markoff theorem. However, the theorem requires the specification of the covariances of the sound speed perturbation field, which is generally not exactly known. Via computer simulation, we examined the sensitivity of the estimate to uncertainty in the sound speed field correlation specified. In addition, we also examined the effects of an increased random experimental noise level and a change in array geometry due to mooring failure on the estimate. The three major results are that: (1) the estimate is less sensitive to a positive uncertainty in correlation length than to a negative uncertainty in an ocean volume containing large structures, while it is more sensitive to a positive uncertainty than to a negative uncertainty in an ocean volume containing small structures; (2) the estimate error is primarily bias error rather than random error; and (3) the failure of a mooring causes a large increase in RMS error in regions no longer containing acoustic rays, but it results in an increase in RMS error of only 25% in regions which still contain acoustic rays.

CIRCUIT MODELS FOR INDUCTIVE STRIPS IN FIN-LINE

Georgios Karaminas - Lieutenant Hellenic Navy

B.S., Hellenic Naval Academy, 1979

Master of Science in Electrical Engineering - December 1989

Advisor: J. B. Knorr - Department of Electrical and Computer Engineering

This thesis describes a CAD compatible circuit model for an inductive strip centered in WR (90) fin-line with $W/b < 1$, $E = 1$. The circuit model is shown to predict strip scattering coefficients which agree closely with those computed numerically using the spectral domain method.

A GENERIC SET OF HF ANTENNAS FOR USE WITH SPHERICAL MODE EXPANSIONS

Nedim Katal - First Lieutenant, Turkish Army

B.S., Turkish Army Academy, 1981

Master of Science in Electrical Engineering - March 1990

Advisor: R. W. Adler - Department of Electrical and Computer Engineering

An antenna engineering handbook and database program has been constructed by engineers at the Lawrence Livermore National Laboratory (LLNL) using the Numerical Electromagnetics Code (NEC) antenna modeling program to prepare data performance on tactical field communication antennas used by the Army. It is desirable to have this information installed on a personnel computer (PC), using relational database techniques to select antennas based on performance criteria. This thesis obtains and analyses current distributions and radiation pattern data by using NEC for the following set of four (4) high frequency (HF) tactical generic antennas to be used in future spherical mode expansion work: a quarter wavelength basic whip, a one-wavelength horizontal quad Loop, a 546-foot longwire, and a sloping "vee beam" dipole. The results of this study show that the basic whip antenna provides good ground wave communication, but it has poor near vertical incident skywave (NVIS) performance. The current distribution has the characteristics of standing waves. The horizontal quad loop antenna is good for NVIS and medium range skywave communications. The current distribution is sinusoidal and continuous around the loop. The long wire antenna allows short, medium and long range communications and a standing wave current distribution occurs along the antenna axis due to non-termination. The sloping "vee beam" antenna favors long range communication and the current distribution is mainly that of travelling sinusoidal waves. Because of their well-known efficiency, the basic whip and quad loop can be used as reference standards for the spherical mode expansion work. The longwire and sloping "vee beam" antenna are unwieldy, but they are effective as base station antennas.

BLOCK LANCZOS ALGORITHM

Yong Joo Kim - Captain, Korean Army

B.S.E.E., Korea Military Academy, 1984

Master of Science in Electrical Engineering - December 1989

Advisor: M. Tummala - Department of Electrical and Computer Engineering

We use a block Lanczos algorithm for computing a few of the smallest eigenvalues and the corresponding eigenvectors of a large symmetric matrix rather than computing all the eigenvalue-eigenvector pairs. The basic Lanczos algorithm generates a similar matrix which is block tridiagonal from a given large symmetric matrix. The size of the generated tridiagonal matrix depends upon the number of the smallest eigenvalues to be computed. The result is savings in computations and storage. The block Lanczos algorithm is well-suited for problems involving multiple eigenvalues. In this thesis, we develop the block Lanczos algorithm to estimate the direction-of-arrival (DOA) of a point source based on the observations measured at a linear array of sensors and compare the performance with that of a single vector Lanczos algorithm. The results of the computer simulation experiments conducted with this method are presented and discussed.

SEPARATION OF SIMULTANEOUS WORD SEQUENCES USING MARKOV MODEL TECHNIQUES

James L. Kingston - Captain, United States Marine Corps

B.S., Rensselaer Polytechnic Institute, 1984

Master of Science in Electrical Engineering - September 1990

Advisor: C. W. Therrien - Department of Electrical and Computer Engineering

This thesis develops a method of separating multiple simultaneous conversations through the use of Markov models. Text samples which represent the conversations to be used as training data are described by a grammar based upon the word and word-pair occurrences within the text. This grammar is then used to establish a Markov model for the text. These models are then combined to form a Markov model which describes the simultaneous occurrence of multiple conversations. Artificially generated word sequences which have the same grammar as the training conversations are supplied as input to the conversation filter, whose purpose is to "listen to" one of the input sequences. The conversation filter takes on either an optimal form in which the grammars of all input sequences to the filter are known, or a sub-optimal form which uses only the grammar of the desired output sequence. The conversation filter utilizes the Viterbi algorithm to extract the optimal text sequence for a best match to the grammar of the desired output. Analysis is performed to determine the efficiency of the algorithm and the performance of the algorithm for varying degrees of similarity between the grammars being separated.

EFFECTS OF NON-UNIFORM WINDOWING IN A RICIAN-FADING CHANNEL AND SIMULATIONS OF ADAPTIVE AUTOMATIC REPEAT REQUEST PROTOCOLS

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B.S., United States Coast Guard Academy, 1984

Master of Science in Electrical Engineering - June 1990

Advisor: T. T. Ha - Department of Electrical and Computer Engineering

Two aspects of digital communication were investigated. In the first part, a FFT-based, M-ary FSK receiver in a Rician-fading channel was analyzed to determine the benefits of non-uniform windowing of sampled received data. When a frequency offset occurs, non-uniform windowing provided better FFT magnitude separation. The improved dynamic range was balanced against a loss in detectability due to signal attenuation. With large frequency offset, the improved magnitude separation outweighed the loss in detectability. An analysis was carried out to determine what frequency deviation is necessary for non-uniform windowing to outperform uniform windowing in a slow Rician-fading channel. Having established typical values of probability of bit errors, the second part of this thesis looked at improving throughput in a digital communications network by applying adaptive automatic repeat request (ARQ) protocols. The results of simulations of adaptive ARQ protocols with variable frame lengths is presented. By varying the frame length, improved throughput performance through all bit error rates was achieved.

MACROOTLOCUS, A CAD DESIGN TOOL FOR FEEDBACK CONTROL SYSTEMS

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B.S.E.E., Korean Air Force Academy, 1980

Master of Science in Electrical Engineering - December 1989

**Advisor: G. J. Thaler - Department of Electrical and
Computer Engineering**

MacRootLocus, a computer-aided design program, was developed as an analysis and design tool for linear feedback control systems. A variety of programs are presently available for the IBM-PC and IBM mainframe. The Apple Macintosh offers just a one-parameter root locus method capability. MacRootLocus supports both one-and two-parameter root locus methods on the Apple Macintosh. It is written in the computer language Turbo Pascal which is the native language of the Apple Macintosh and is designed with the same user-friendliness and standard interface philosophy the Macintosh was designed for.

EXPERIMENTAL INVESTIGATION OF A MM-WAVE PLANAR ANTENNA

Georgios D. Lambrakskis - Lieutenant, Hellenic Navy

B.S., Naval Academy, 1980

Master of Science in Electrical Engineering - June 1990

Advisor: R. Janaswamy - Department of Electrical and Computer Engineering

This thesis investigates a new mm-wave Bilateral Slot Line (BSL) antenna and its relation to the Linearly Tapered Slot Antenna (LTSA). The BSL antenna consists of a tapered double-sided slotline and can be viewed as two identical LTSAs sandwiched back to back. Dielectric substrates with permittivities of 2.33 and 6.0 were used to construct these antennas. The theoretical background, the design, and the performance in the frequency range 5-9 GHz of the new microwave integrated circuit antenna is presented. The effects of several parameters such as dielectric constant, stripline, and slotline characteristics impedance, antenna structure, and transition scheme on the radiation patterns and return loss were experimentally investigated. Some relationships between the width of stripline and slotline, their characteristics impedance and the dielectric constant are reported. Guidelines are laid down to design the LTSA and BSL antennas.

EVALUATION OF SYSTEM IDENTIFICATION ALGORITHMS FOR ASPECT- INDEPENDENT RADAR TARGET CLASSIFICATION

Peter David Larison - Captain, United States Marine Corps

B.S., Xavier University, 1981

Master of Science in Electrical Engineering - December 1989

Advisor: M. A. Morgan - Department of Electrical Engineering

A radar target, acting as a scatterer of an incident electromagnetic wave, can be considered as a linear time-invariant system. Previous work has shown that the target's pole locations are independent of the incident electromagnetic excitation, including incident wave shape, aspect and polarization. This thesis develops the Kumaresan-Tufts and Cadzow-Solomon signal processing algorithms into computer routines and evaluates their pole extraction performance. Data used to evaluate the extraction algorithms includes synthetic and integral equation generated signals with additive noise, in addition to measurements of scattering by scale models made in an anechoic chamber.

A REDUCED-ORDER EXTENDED KALMAN FILTER FOR MOVING IMAGES

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B.S., Biology, West Virginia Wesleyan College, 1980

Master of Science in Electrical Engineering - December 1989

Advisor: J. B. Burl - Department of Electrical and Computer Engineering

An extended Kalman filter is used to estimate the velocity of an object moving across an image frame and to reduce the undesirable effects of noise. The extended Kalman filter is implemented in the spatial frequency domain to reduce the number of computations. The resulting filter structure is a parallel bank of third-order extended Kalman filters. This parallel structure is referred to as the modified extended Kalman filter. The performance of the modified extended Kalman filter is evaluated under a variety of noise conditions using computer simulations. Simulations employed two test objects moving across a reference image in the presence of zero-mean, white, Gaussian noise. The performance of the filter was demonstrated when these objects were moved at integer and noninteger velocities. Performance was also evaluated when a stationary background was included with the white noise.

NUMERICAL PULSE PROPAGATION STUDIES USING TWO CLASSICAL OCEAN WAVEGUIDE MODELS

**Marinos P. Markopoulos - Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1980
Master of Science in Electrical Engineering - December 1989
Advisor: L. J. Ziomek - Department of Electrical and
Computer Engineering**

Numerical pulse propagation studies using two classical ocean waveguide models are performed. The first model is a pressure-release surface with a rigid bottom. The second model is a pressure-release surface with a fluid bottom. The analysis of the two models is based on normal mode theory assuming a constant speed of sound in the ocean. The magnitude and phase of the complex acoustic pressure field as a function of frequency is calculated across a planar array of hydrophones. The time-domain output electrical pulse from the center element in the array is also computed. The computer simulation results for the two models are compared and discussed.

AIRCRAFT MANEUVER DETECTION USING AN ADAPTIVE KALMAN FILTER

**Hsing Han Meng - Lieutenant, R.O.C. Navy
B.S., Chung Cheng Institute of Technology, 1984
Master of Science in Electrical Engineering - December 1989
Advisor: J. B. Burl - Department of Electrical and
Computer Engineering**

In the target tracking problem the main purpose is to get an accurate estimation of target states. In order to achieve good estimation, the study of target maneuver detection is important. An estimator that computes a constant input acceleration vector is first derived in this thesis. It employs the concept of least square estimation with data consisting of the residuals of the simple Kalman filter. A detector for sensing the target maneuver using the input estimates based on a fixed number of measurements is developed. Finally, the combination of the estimator, detector, and the simple Kalman filter is developed to form a tracker for maneuvering targets. The maneuvering target tracker developed experiences problems due to errors in maneuver start-time detection and the computation load associated with using a variable-length window to estimate the input. Therefore, a modified input estimation method for tracking a maneuvering target is presented. It uses only a fixed number of measurements to compute the input estimates and employs a scaling factor to correct the input estimates for feeding back to a second Kalman filter (used for maneuvering target tracking). The results of target tracking using these different methods are presented in this thesis and the modified input estimation method turns out to yield better tracking of maneuvering targets in some applications.

VIDEO TRACKING OF OBJECTS ON AN ENHANCED PC SYSTEM

**Paul Merritt - Captain, United States Army
B.S., United States Military Academy, 1982
Master of Science in Electrical Engineering - December 1989
Advisor: R. Cristi - Department of Electrical and
Computer Engineering**

This research addresses the problem of fast edge detection for real-time tracking of moving objects. In particular, an implementation suitable to microcomputer application is presented which includes a novel approach of edge detection based on Kalman filtering techniques. Applications to automatic road following show the effectiveness of the technique.

TERRAIN ANALYSIS USING LANDSAT THEMATIC MAPPER IMAGERY

Gerald T. Michael - Captain, United States Army

B.S., Massachusetts Institute of Technology

Master of Science in Electrical Engineering - March 1990

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

This study examined two sites from a Landsat scene of portions of Honduras and Nicaragua. One site was examined for potential water obstacles, and the other was examined for cover and concealment provided by vegetation. The results suggest that potential water obstacles can be detected. It is not clear if vegetative cover and concealment can be reliably detected. A study using better ground reference information than was available is necessary to answer that question. Several unsupervised classification algorithms were used and compared. A histogram clustering algorithm followed by a minimum distance classifier provided results comparable to the much slower K-means and isodata-type algorithms. Several methods to reduce the dimensionality of the classification problem were examined, including band subsets, between-band ratios, the principal component transformation, and the tasseled cap transformations. Band subsets provided adequate accuracy and is the easiest method to implement.

INTRODUCTION OF A CURRENT WAVEFORM, WAVESHAPING TECHNIQUE TO LIMIT CONDUCTION LOSS IN HIGH-FREQUENCY DC-DC CONVERTERS SUITABLE FOR SPACE POWER

Douglas P. Miller - Lieutenant, United States Navy

B.S.E.E., State University of New York Maritime College, 1982

Master of Science in Electrical Engineering - June 1990

Advisor: G. D. Ewing - Department of Electrical and Computer Engineering

Space power supply manufacturers have tried to increase power density and construct smaller, highly efficient power supplies by increasing switching frequency. Incorporation of a power MOSFET as a switching element alleviates switching loss. However, values of $R_{DS(ON)}$ (drain to source resistance in the on-state) for MOSFET's are of such magnitude to produce greater on state-losses than an equivalent BJT operated in saturation. This research serves to introduce a design concept, pertinent to low-voltage relatively-high-current applications, that minimizes the peak current through the switching element in order to reduce average power loss. Basic waveforms produced by different PWM and resonant mode topologies were examined. Theoretical analysis reveals that a ramp-sine current waveform could cut conduction power loss by at least 18% over a conventional Buck switching converter. A 14V, 14W combination quasi-resonant Buck/ZCS, Quasi-Resonant Buck dc-dc converter with an unregulated input voltage of 28 V was built for simplicity to demonstrate one particular waveshaping technique. This converter represents a useful example of an actual circuit which is capable of producing the desired ramp-sine switch-current waveform. Final results confirm improvement in conduction loss enhancing existing power MOSFET technology for use in dc-dc power conversion.

VHDL SIMULATION OF THE IMPLEMENTATION OF A COSTFUNCTION CIRCUIT

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B.S., Royal Thai Naval Academy, 1980

Master of Science in Electrical Engineering - September 1990

Advisor: C. H. Lee - Department of Electrical and Computer Engineering

Since VHDL is a DoD standard hardware description language, it is widely used in the design of logic circuits at different levels. VHDL can be used to do behavioral modeling which is desirable in top-down system design. A costfunction calculation in a graph partition algorithm is used here as an example to test the VHDL design methodology. Subroutines or statements in the software can be implemented into hardware if the subroutines or the statements in that software are suitably grouped. While the design of hardware is considered, high density integration of circuit is also the primary goal. Parts of an old design were condensed using programmable EPLDs which were programmed by commercial software development tools. The methodology of implementation goes from a register transfer language description to data flow design and control flow design. The costfunction calculation was successfully put into 4 EP1800 chips and the design was simulated in VHDL. The primary goal of integration was achieved at the expense of speed. To support the total simulation several behavior models were created. Results of simulation revealed that the adder circuit in the EP1800 can be further improved. Experiences of using VHDL are discussed in this thesis.

**NATURAL RESONANCE EXTRACTION AND ANNIHILATION FILTERING METHODS
FOR RADAR TARGET IDENTIFICATION**

**Timothy James Murphy - Captain, United States Marine Corps
B.A.E.M., University of Minnesota**

Master of Science in Electrical Engineering - September 1990

Advisor: M. A. Morgan - Department of Electrical and Computer Engineering

This thesis represents an initial attempt to demonstrate aspect independent target identification of complex radar targets using annihilation filters based on the natural resonances of the targets. The Cadzow-Solomon signal processing algorithm is tested to determine its suitability for the task of extracting the poles from complex targets to a degree of accuracy required for successful implementation of an annihilation filtering target identification system. This testing was conducted through the use of noise polluted synthetic data as well as measured transient scattering data from thin-wire and silver coated scale model aircraft targets. The testing revealed that the Cadzow-Solomon algorithm can return pole clusters at false pole locations when processing the scattered returns from complex targets. Properties of annihilation filters which may affect their ability to discriminate complex targets are examined.

**APPLICATION OF MULTI-FREQUENCY MODULATION (MFM) TO
FACSIMILE MACHINES**

**James T. Nickerson - Lieutenant Commander, United States Navy
B.S.E.E., United States Naval Academy, 1977**

Master of Science in Electrical Engineering - September 1990

Advisor: P. H. Moose - Department of Electrical and Computer Engineering

Multi-Frequency Modulation (MFM) has been developed at NPS using both differential quadrature-amplitude-modulation (DQAM) and differential quadrature-phase-shift-keying (DQPSK) encoding formats. This report discusses the use of each of these formats in transmitting a facsimile encoded message over a voice frequency channel. The satisfactory transmission and receipt of facsimile messages was achieved using both DQPSK and D16-QAM encoding formats. Research and testing for this report included the use of variable facsimile transmission rates in an attempt to optimize MFM operating parameters. Experimental results revealed a higher error rate when decoding messages contained similar contiguous characters.

PRELIMINARY DESIGN OF THE PANSAT ELECTRICAL POWER SUBSYSTEM (EPS)

**Michael L. Noble - Lieutenant Commander, United States Navy
B.S., Maine Maritime Academy, 1978**

Master of Science in Electrical Engineering (Space Systems Engineering) - June 1990

Advisor: G. D. Ewing - Department of Electrical and Computer Engineering

This Thesis presents a preliminary design of the electrical power system (EPS) for the Naval Postgraduate School's Petite Amateur Navy Satellite (PANSAT). The EPS is a photovoltaic silicon cell system consisting of solar array, batteries, battery charge regulator (BCR), and dc-dc convertors. The EPS provides power for up to two years of low earth orbit (480) km) operations. The solar array consists of 17 panels with thirty-two 2X4 cm solar cells in series on each panel. The cells have an efficiency of 14.3% and generate a panel voltage of 14.1 volts at beginning of life, providing an unregulated bus voltage of 13.5 volts. The bus voltage is clamped at a minimum 10.5 volts by two lead acid batteries in parallel with the bus. Each battery consists of five 2.1 volt, 5 ampere-hour lead acid cells and is capable of meeting mission requirements. The FBCR monitors individual battery voltage, an indication of reserve capacity, and provides a pulse modulated charge current alternately to each battery. The BCR is redundant with no single point of failure. Power conditioning for the unregulated bus is provided by redundant dc-dc convertors. The prototype BCR test results are presented along with alternative methods of increasing power output and efficiency.

PERFORMANCE STUDY OF A MARINE EXPEDITIONARY FORCE RADIO SYSTEM

Allen L. Noel - Captain, United States Marine Corps

B.S.E.E., The Citadel, Charleston, SC, May 1982

Master of Science in Electrical Engineering - September 1990

Advisor: T. T. Ha - Department of Electrical and Computer Engineering

A computer simulation model of the U.S. Marine Corps Marine Expeditionary Force's high frequency and very high frequency voice radio system was developed. The model's performance, under varying message traffic loads and jamming, was evaluated and compared to two computer models that incorporate telephone switching techniques to access multiple radio circuits. A radio circuit switch mathematical model was developed utilizing an Engset distribution for a telephone exchange to calculate the key parameters and verify the results of the simulation model. Based on the results of the simulation, the implementation of the proposed system is discussed with the goal of minimizing modifications to existing equipment and procedures.

APPLICATION OF THE CONSTRAINED IMPLICANTS SET CONCEPT TO THE MINIMIZATION OF BINARY FUNCTIONS

Ugur Ozkan - Lieutenant Junior Grade, Turkish Navy

B.S., Turkish Naval Academy, 1984

Master of Science in Electrical and Computer Engineering - September 1990

Advisors: C. Yang & J. T. Butler - Department of Electrical and Computer Engineering

Several heuristics and algorithms have been developed to find minimal sum-of-products expressions in binary logic. Most of them use prime implicants during minimization process. An efficient search strategy has been developed for finding minimal sum-of-products expressions for multiple-valued logic (MVL) functions by using the constrained implicants set concept. The search space can be considerably reduced over the only other known exact minimization technique and exhaustive search. The primary goals of this research are to: (1) examine whether the constrained implicant set concept can be efficiently used in binary logic, and (2) develop a heuristic called the constrained implicant set heuristic (CISH). The general idea of the CISH is to select the minterm with the least implicant cover size and find the implicant with the largest minterm coverage that covers a selected minterm. In this research, the implementation of the CISH is presented, the performance analysis of the CISH is shown by comparing with other heuristics (Maximum Implicant Heuristic, Espresso II) with respect to the average number of the product terms, the average computation time, and the average memory usage.

AUTOMATED FIBER OPTIC MEASUREMENTS

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B.S., Federal University of Para, 1977

Master of Science in Electrical Engineering - December 1989

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

The objective of this work was to implement an automated optical measurement system for use with fiber optic systems. This system controls data acquisition, processes the acquired data and optimally displays results of optical experiments. The primary constituents of the experimental design were: a Hewlett-Packard Hp-87 used as the computer controller, the Tektronix OF235 Reflectometer, the Photodyne 22XLA Fiber Optic Multimeter and the 2275XQ Test Set. These devices were integrated through the General Purpose Interface Bus (GPIB) and software was developed to control the operation of the system. The system is capable of measuring many fiber parameters such as attenuation, index of refraction, loss characteristics as well as detecting and locating faults and breaks in single-mode fibers. In addition, the system possesses peripheral devices to store the data and to produce permanent records of the results.

**DIGITAL SIGNAL PROCESSING SOFTWARE PACKAGES FOR IBM-PC AND
IBM-PC WITH DSP-16**

**Gregory James Pitman - Lieutenant Commander, United States Navy
B.A., Culver-Stockton College, 1976**

Master of Science in Electrical Engineering - December 1989

Advisor: M. Tummala - Department of Electrical and Computer Engineering

This thesis provides two versions of a digital signal processing (DSP) program that can be used by an individual interactively. The intended user for this program is a student taking a digital speech signal processing class at the Naval Postgraduate School. Nevertheless, the implemented algorithms can be used to analyze any slowly time-varying signal. One version uses a MS-DOS computer (or IBM-compatible) for both data handling and for the DSP algorithms. The other version uses the MS-DOS computer for data handling and uses an Ariel DSP-16 digital signal processing board for the DSP algorithms. All algorithms are implemented in a non real-time mode. The program uses the same user-interface software for both versions. The user-interface software package provides a user-friendly input and output environment.

**A METHODOLOGY FOR PRODUCING AND TESTING A GENESIL SILICON COMPILER DESIGNED
VLSI CHIP WHICH INCORPORATES DESIGN FOR TESTABILITY**

**Brian Lee Pooler - Captain, United States Marine Corps
B.S.E.E., United States Naval Academy, 1979**

Master of Science in Electrical Engineering - September 1990

Advisor: H. H. Loomis - Department of Electrical and Computer Engineering

Testability issues concerning the need for including Design for Testability (DFT) techniques in VLSI designs are discussed. Types of fault models, the use of fault simulation and the DFT techniques of Scan Path and Built-in Test are described. An engineering methodology that uses the Genesil Silicon Compiler to produce a VLSI design, DFT CHIP, which utilizes the DFT Scan Path technique is presented. Included are the procedures for using Genesil's simulation, timing analysis and automatic test generation features. The steps taken to fabricate the DFT CHIP design through MOSIS are discussed. The methodology used to test the fabricated DFT CHIP design on the Tektronix DAS 9100 tester is described. Appendix A and Appendix B provide copies of the Genesil check functions written for use during simulation on the DFT CHIP design. Appendix C specifies the Genesil timing information for the DFT CHIP design. Appendix D lists the conversion program which translates Genesil produced test vector files to the file format used during testing on the Tektronix tester.

**A MICROCOMPUTER-BASED CONTROLLER FOR AN AUTONOMOUS
UNDERWATER VEHICLE (AUV)**

**William David Rilling - Lieutenant, United States Navy
B.S., Middle Tennessee State University, 1983**

Master of Science in Electrical Engineering - March 1990

Advisor: R. Cristi - Department of Electrical and Computer Engineering

Considerations of real-time control problems for an Autonomous Underwater Vehicle (AUV) are addressed in this research. Among these problems is the ability to control the submersible given its highly nonlinear operating environment. In order to account for these variations, robust control techniques must be used. In particular, Variable Structure Control (VSC) with Doyle-Stein Observer has proven to produce optimal results while maintaining a high degree of robustness. This led to the development of a real-time error detector using the robust observer to provide system redundancy through software. The culmination of this work is a real-time autopilot written in the "C" language which is ready for implementation and testing in the Naval Postgraduate School AUV prototype. We also address the aspect of real-time signal processing and condition in terms of Synchro-to-Resolver Conversion and anti-aliasing filters. The synchro problem involves converting a nonpotentiometric directional gyro output to a natural binary format which calls for an intricate design of power transformers, analog-to-digital converter, and passive element components. Lastly, the use of Generalized-Immittance Converter circuitry in the design of very low frequency anti-aliasing filter applications is developed and tested.

**APPLICATION OF MULTI-FREQUENCY MODULATION (MFM) FOR HIGH-SPEED
DATA COMMUNICATIONS TO A VOICE FREQUENCY CHANNEL**

**Charles P. Salsman - Lieutenant Commander, United States Navy
B.S.I.E., University of Tennessee, 1977**

Master of Science in Electrical Engineering - June 1990

Advisor: P. H. Moose - Department of Electrical and Computer Engineering

Multi-Frequency Modulation (MFM) has been developed at NPS using both differential quadrature-phase-shift-keying (DQPSK) and differential-quadrature-amplitude-modulation (DQAM) encoding formats. Previous applications of these encoding formats were on industry standard computers (PC) over a 16-20 kHz channel. This report discusses the implementation of MFM to a voice frequency channel of 200-3400 Hz, for possible future use with high-speed modems over switched telephone networks. Research and testing for this report included the DQPSK and differential 16-quadrature-amplitude-modulation (D16-QAM) encoding formats implemented on PC's. Experimental results of the implemented MFM signal were comparable to theory with acceptable bit error rates for input signal-to-noise ratios (SNR) of 15 dB and higher.

**PERFORMANCE ANALYSIS OF HIGH FREQUENCY SINGLE-SITE-LOCATION
ANTENNA ARRAYS USING NUMERICAL ELECTROMAGNETIC MODELING**

**Harry Thornberry Schiantarelli - Commander, Peruvian Navy
Master of Science in Electrical Engineering & Systems Engineering
(Electronic Warfare) - September 1990**

Advisor: R. W. Adler - Department of Electrical and Computer Engineering

Electronic support measures (ESM) systems play an increasingly important role in modern warfare and can influence the outcome of a military engagement. The application of ESM can be extended to anti-guerrilla and anti-drug operations where law enforcement agencies can exploit the fact that their presence is inducing the outlaw to depend more on radio communications to coordinate their activities. When a propagation path of no more than one reflection at the ionosphere (1-hop) can be assumed, position of an HF emitter can be determined by a single observing site using vertical triangulation, provided that the height of the ionosphere at the point where the radio wave is reflected, can be determined. This technique is known as "high frequency direction finding single-site-location" (HFDF SSL). This thesis analyzes the HFDF SSL error in measuring the direction of arrival of the signal, how this error is generated by the antenna array and its effect on emitter location. The characteristics of the two antenna arrays used by a specific HFDF SSL system that implements the phase-interferometer technique were studied using electromagnetic modeling. Results showed that angle-of-arrival errors for the high band array were less than 0.5° and were under 0.2° for the low band antenna system. The maximum HFDF SSL lateral and range error of this system were found to be 8.7 km and 22.4 km respectively for the high band array, when the targeted emitter is located at 500 km, and the incoming wave has an E-propagation mode. The smallest lateral and range error were found to be 2.1 km and 4.3 km respectively for the low band array, when the targeted emitter is located at 300 km, and the incoming wave has an E-mode.

PARALLEL-PROCESSOR BASED GAUSSIAN BEAM TRACER FOR USE IN OCEAN ACOUSTIC TOMOGRAPHY

Roderick Spencer Scott - Captain, Canadian Forces

B. Eng., Royal Military College of Canada, 1984

Master of Science in Engineering Acoustics & Electrical Engineering - June 1990

Advisors: J. H. Miller - Department of Electrical and Computer Engineering

C. S. Chiu - Department of Oceanography

C. Yang - Department of Electrical and Computer Engineering

This thesis presents a parallel-processor-based acoustic ray tracing algorithm for use in predicting multipath arrival times and amplitudes, for use in ocean acoustic tomography experiments. The Runge-Kutta-Fehlberg numerical integration method was chosen, out of three other methods, to numerically solve the ray equations. Cubic splines were used to interpolate the sound speed profile bottom bathymetry data. The method of Gaussian beam tracing was used to compute the multipath amplitudes at a given receiver location. The ray tracing algorithm in C, and is designed to run using a Macintosh II-based host application and a transputer-based, parallel processing workfarm.

AN ARTIFICIAL NEURAL NETWORK CONTROL SYSTEM FOR SPACECRAFT ATTITUDE STABILIZATION

Clement M. Segura - Lieutenant, United States Navy

B.S.S.E., United States Naval Academy, 1982

Master of Science in Electrical Engineering - June 1990

Advisor: J. B. Burl - Department of Electrical and Computer Engineering

This document reports the results of research into the application of artificial neural networks to controlling dynamic systems. The network used is a feed-forward, fully-connected, 3-layer perceptron. Two methods of training neural networks via error back-propagation were used. Pattern matching training is a direct method that teaches the basic response. Performance index training is a new technique that refines the response. Performance index training is based on the concept of enforced performance. A neural network will learn to meet a specific performance goal if the performance standard is the only solution to a problem. Performance index training is devised to teach the neural network the time-optimal control law for the system. Real-time adaptation of a neural network in closed loop control of the Crew/Equipment Retriever was demonstrated in computer simulations.

DESIGNING A VIRTUAL-MEMORY IMPLEMENTATION USING THE MOTOROLA MC68010 16-BIT MICROPROCESSOR WITH MULTI-PROCESSOR CAPABILITY INTERFACED TO THE VMEBUS

David M. Sendek - Lieutenant, United States Navy

B.S., The College of Charleston, 1981

Master of Science in Electrical Engineering - June 1990

Advisor: L. W. Abbott

The primary purpose of this thesis is to explore and discuss the hardware design of a bus-oriented microprocessor system. A bus-oriented microprocessor system permits it to be expanded to a multi-processor system. Through the use of a bus controller and bus arbiter, as discussed in this thesis, the necessary logic is in place to control bus access by system users. Bus access may be initiated to share another sub-system's resource, such as memory. To accommodate memory sharing between two systems, a dual-port memory controller can be used to resolve memory access between the two systems. This thesis discusses the design of a MC68010 microprocessor system integrated on the VMEbus with dual-ported memory capability. Additional features of the MC68010 microprocessor system include memory-management and interrupt control. The memory-management features permit protected memory and virtual-memory to be implemented on the system, while an interrupt handler is used to assist the MC68010 microprocessor in exception processing.

COMPARISON OF SLOTLINE CHARACTERISTICS

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B.S., Army Academy, 1981

Master of Science in Electrical Engineering - June 1990

Advisor: R. Janaswamy - Department of Electrical and Computer Engineering

The slot width required for conventional slotlines is very narrow when etched on low dielectric constant substrates. This poses fabrication difficulties and discourages the use of slotlines on these substrates. However, the slotline is finding increased applications in slot antennas. In order to feed the slot antennas, alternate structures must be found that relax the fabrication difficulties. Two such new structures are the bilateral slotline and the asymmetric slotline [Refs. 6,7]. In this thesis, design data was developed and comparison was made between the various slotlines with regard to the substrate parameters and the slot width. Use was made of computer codes already developed for these structures.

A PERFORMANCE STUDY OF THE CONCURRENCY CONTROL ALGORITHMS IN HIERARCHICAL NETWORK WITH PARTITIONED DATABASE

Eon Seok Shin - Captain, Korean Army

B.S., Korea Military Academy, 1983

Master of Science in Electrical Engineering - March 1990

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

It is common to have a hierarchical communication network in a military environment. If we consider each node in the network as a computer site then we have a hierarchical computer network. In a hierarchical computer network, because the need of resource sharing, we now have a distributed processing system. In this system a parent node may have duplicate records of all its children. Any update of a record has to be reflected in other nodes that keep the duplicates. We need a concurrency control mechanism to guarantee the integrity of the distributed database and the serializability of concurrent updates. This paper is the first to investigate the performance in hierarchical networks of two widely-cited concurrency control mechanisms, locking based and timestamp. Various parameters are investigated in our research: number of nodes, level of network, transaction arrival rates, and message transmission speeds, etc. We present the problem, explain the algorithms used in our simulation, analyze the results, and discuss the findings.

EPLD MODELING WITH VHDL

Shih-Ming Shu - Lieutenant, Taiwan Republic of China Navy

B.S., Chinese Naval Academy 1985

Master of Science in Electrical Engineering - December 1989

Advisor: C. H. Lee - Department of Electrical and Computer Engineering

Incompatibility between separately-designed subsystems has long been a problem in the logic design industry. This problem greatly affects the productivity of logic design procedures. It also makes system maintenance and second source procurement very difficult. The military and IEEE 1076 standard hardware description language VHDL is a promising solution to this problem. In this thesis, the VHDL language was used to model an industry-wide popular device - erasable programmable logic device (EPLD). The EPLD modeling problems are discussed via the modeling of two EPLD chips, EP310 and EP1800. The solutions to these problems are described and tested. The goal of this thesis is to provide examples of VHDL coding techniques related to the EPLD modeling. These coding techniques with the associated EPLD library can be used to support future system level logic design.

INSTANTANEOUS POWER SPECTRUM

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Master of Science in Electrical Engineering - March 1990

Advisor: R. D. Hippenstiel - Department of Electrical and Computer Engineering

The estimation of time varying spectra is a complicated one. The use of classical techniques coupled with the local stationarity assumption is met with only moderate success. Of the many time-frequency distribution functions used in the signal analysis, none present fully satisfactory spectra. The performance of the spectrogram, Instantaneous Power Spectra (IPS) the Wigner-Ville distribution (WD) and various aspects of the Rihaczek distribution (RD) for a variety of signal nonstationarities are compared. WD has the most narrow main-lobes but suffers from spectral cross-terms. IPS, the real part of the RD consistently shows a broadened main-lobe without cross-terms. The squared magnitude of the RD places sharp peaks along the crest of the main-lobe and is otherwise very similar to IPS. The imaginary part of the RD shows a sensitivity to discontinuous frequency changes i.e., frequency shift keying.

VLSI DESIGNS FOR PIPELINED FFT PROCESSORS

David Charles Stuart - Lieutenant, United States Navy

B.S., Southern Illinois University at Carbondale, 1979

Master of Science in Electrical Engineering and

Electrical Engineer - June 1990

Advisor: H. H. Loomis - Department of Electrical and Computer Engineering

A system of custom cell building blocks utilizing scaleable CMOS technology is described. The cells are designed to support the high speed, pipelined addition, subtraction, and multiplication operations necessary in a cyclic spectral analyzer or other applications involving the FFT. The cells are structured in such a manner as to permit a designer to tailor the bit-length of the operations and the number of pipeline stages used. Both fixed and floating operations are supported by the system. The size and performance characteristics of devices produced using the cells are compared with previously produced Genesil Silicon Compiler pipelined designs. The appendix contains designs of a 16-bit mantissa, 12-bit exponent floating point multiplier and adder produced from the standard cells. If fabricated in 1.2- μ feature size technology, the theoretical maximum clock speed and throughput rate is 102 MHz with an asymmetric clock and 61 MHz using a symmetric clock waveform. Devices with clock speeds up to 178 MHz are possible if the number of logic cells between a pipeline stage is reduced to one.

THE PATH PREDICTION OF CYCLONES WITH KALMAN FILTERS

Dogan Taskin - LTJG, Turkish Navy

B.S., Turkish Naval Academy, 1984

Master of Science in Electrical Engineering - September 1990

Advisor: H. Titus - Department of Electrical and Computer Engineering

The Kalman filter is used to provide estimates of the position and velocity of a storm based upon observation of the storm's longitude and latitude. Nonstationary noise is shown to degrade the performance of the filter and cause tracking divergence. Time varying values for the noise covariance matrices R and Q, and the addition of an external forcing function to the filter effectively compensated for this tracking error. Results for the simulations show significant performance advantages in using external forcing functions in the system.

**DESIGN AND IMPLEMENTATION OF AN MC68020-
BASED EDUCATIONAL COMPUTER BOARD**

**Yavuz Tugcu - First Lieutenant, Turkish Air Force
B.S., Middle East Technical University, Ankara, 1981**

Master of Science in Electrical Engineering - December 1989

Advisor: G. J. Lipovski - Department of Computer Science

The goal of this thesis is to design and implement a Motorola 68020 based Educational Computer Board (ECB), including the Motorola 68881 coprocessor. The ECB has two communication channels, one for an external I/O device and the other for a Macintosh personal computer. A stored program can be installed in 8K bytes Programmable Read Only Memory (PROM) to initialize the ECB and to handle communication, as well as to perform user commands via a Macintosh personal computer. The ECB operates at a clock frequency of 16 MHz. It includes four Static Random Access Memory (SRAM) chips which provide a storage of 32K bytes. Two Programmable Array Logic (PAL) chips generate the required decoding, enabling and timing signals. No special I/O chip is used in Macintosh interface, except for a RS-232 line driver/level changer, as the communication on this channel is intended to be under software control in order to keep the hardware as simple as possible. The channel for an external device has not been implemented and tested, but all the required pads and holes are available to install 74244 and 74245 TTL line driver IC's for this channel.

**AN EXPERIMENTAL STUDY OF VOICE COMMUNICATION OVER A BANDLIMITED
CHANNEL USING VARIABLE BIT WIDTH DELTA MODULATION**

N. Nur Tumok - Lieutenant Junior Grade Turkish Navy

B.S., Turkish Naval Academy, 1983

Master of Science in Electrical Engineering - December 1989

Advisor: G. A. Myers - Department of Electrical and Computer Engineering

A variable bit width delta modulator (VBWDM) demodulator was designed, build and tested to achieve voice and music communication using a bandlimited channel. Only baseband modulation is applied to the input signal. Since there is no "clock" used during the digitizing process at the modulator, no bit synchronization is required for signal recovery in the receiver. The modulator is a hybrid design using 7 linear and 3 digital integrated circuits (IC), and the demodulator uses 2 linear ICs. A lowpass filter (LPF) is used to simulate the channel. The average number of bits sent over the channel is measured with a frequency counter at the output of the modulator. The minimum bandwidth required for the LPF is determined according to the intelligibility of the recovered message. Measurements indicate an average bit rate required for intelligible voice transmission is in the range of 2 to 4 kilobits per seconds (kbps) and between 2 to 5 kbps for music. The channel 3 dB bandwidth required is determined to be 1.5kHz. Besides the hardware simplicity, VBWDM provides an option for intelligible digitized voice transmission at very low bit rates without requiring synchronization. Another important feature of the modulator design is that no bits are sent when no signal is present at the input which saves transmitter power (important for mobile stations) and reduces probability of intercept and jamming in military applications.

TACTICAL HF FIELD EXPEDIENT ANTENNA PERFORMANCE VOLUME I AND II

Gurkan Turkes - Lieutenant Junior Grade, Turkish Navy

B.S., Turkish Naval Academy, 1982

Master of Science in Electrical Engineering - March 1990

Advisor: R. W. Adler - Department of Electrical and Computer Engineering

This thesis investigates the performance of various configurations of tactical High Frequency (HF) field deployable antennas in the presence of lossy earth. Antennas investigated include horizontal dipoles, short sloping wires, inverted vees, and monopoles with buried and elevated radials. Numerical models of the antennas are exercised via the Numerical Electromagnetics Code (NEC) for radiation pattern performance. Antennas are analyzed for applicability to (1) short-range Near Vertical Incident Skywave (NVIS), where high elevation radiation angles are required, (2) medium- and long-range low radiation angle use, and (3) vertically polarized low-angle radiation for ground wave communication. Good NVIS and ground wave performance occurs for horizontal dipoles. Sloping wires and sloping dipoles are similar to horizontal dipoles but exhibit a moderate amount of azimuth plane directivity. Vertical monopoles with at least 15 buried radials produce medium- and long-range skywave coverage and good ground wave performance. Four elevated radials for quarter-wavelength monopoles are shown to out-perform 15 buried radials and are much easier to erect. The larger and more difficult-to-erect inverted vee dipole slightly outperforms a monopole by virtue of modest azimuth plane directivity. The results of this study can be included in an antenna engineering handbook and can be used to interface with existing ionospheric propagation codes in order to obtain optimum communication effectiveness.

DESIGN AND IMPLEMENTATION OF A DEBUGGER FOR MC68020 BASED EDUCATIONAL COMPUTER BOARD

Mustafa Yavuz Uzunsokakli - Lieutenant Junior Grade, Turkish Navy

B.S.E.E., Turkish Naval Academy

Master of Science in Electrical Engineering - December 1989

Advisor: G. J. Lipovski - Department of Computer Science

A debugger has been designed and implemented to debug MC68020 assembly language programs which run on MC68020-based Educational Computer Board (ECB). The debugger consists of two physically separate modules and runs on both a Macintosh and on the ECB. The debugger and the ECB communicate via an RS232 interface at a Baud rate of 9600. In addition to basic debugger commands for the MC68020, the debugger also supports commands which enable the user to examine or modify the MC68881 Coprocessor's registers. An important feature is that it is user-friendly. It utilizes pull-down menus, where the user can select and execute the desired command simply by clicking the mouse. This debugger and a LightspeedC compiler provides the user with an integrated environment, where he or she can edit, assemble and debug assembly language program. Applications of this software tool, and the accompanying ECB, can be used for both research and teaching. For example, it can replace the current system that supports the Naval Postgraduate School course EC2800.

AN ELECTROMAGNETIC RADOME MODEL USING AN INTERACTIVE MICRO-COMPUTER FINITE ELEMENT ALGORITHM

Robert Johnston Vince - Lieutenant, United States Navy

B.S., Math, Tulane University, 1983

Master of Science in Electrical Engineering and Engineering

Science (Aeronautics) - December 1989

Co-Advisors: M. A. Morgan - Department of Electrical & Computer Engineering &

J. P. Hauser - Department of Aeronautics and Astronautics

The goal of this thesis was to develop and validate a set of microcomputer programs using, in part, a previously written finite-element algorithm to analyze the perturbation of an incident electromagnetic field as it penetrates a missile radome. An interactive program was developed to design the radome structure using aerodynamic shaping functions and provide structure and material files as input to the finite-element code. A second program was developed to use the spherical harmonic expansion coefficients provided by the finite-element code to assemble the selectromagnetic fields within the radome core and to display the fields that appear across a planar antenna with three-dimensional graphics for any orientation of the antenna.

Algorithms were included which compare the computed field components to the theoretical incident plane wave for each stipulated angle of incidence, in order to determine the perturbation due to the presence of the radome. Validation of the computational method was attempted by analyzing the perturbation indicated for an ideal radome with relative permittivity of unity. The attempted validation showed phase errors in the computed fields which were minimal for axial incidence, but became significant for highly canted incidence.

**BANDWIDTH AND SIGNAL TO NOISE RATIO ENHANCEMENT OF THE NPS
TRANSIENT ELECTROMAGNETIC SCATTERING LABORATORY**

Norman J. Walsh - Major, Royal Canadian Armored Corps

B.S.C., Royal Military College of Canada, 1975

Master of Science in Electrical Engineering - December 1989

Advisor: M. A. Morgan - Department of Electrical and Computer Engineering

This thesis describes the development of a parallel GaAs FET amplifier configuration for the Transient Electromagnetic Scattering Range at the Naval Postgraduate School. The implementation of the parallel amplifier configuration improved the bandwidth and the signal-to-noise ratio of the range. Existing software was used to process signals scattered from canonical targets. When interpreted, this data was used to optimize the new amplifier configuration. The upgraded facility is shown to provide measurements having excellent agreement with theoretically predicted signatures of simple canonical shapes. A significant improvement of the signal-to-noise ratio and bandwidth of scattered signatures vis-a-vis that of the previous laboratory configuration is observed. Results are documented for a target library created to facilitate research into a number of scattering problems.

MOVING OBJECT DETECTION BY TRACK ANALYSIS

Chen-Shan Wang - Commander, R.O.C. Navy

B.S.E.E., Chung Cheng Institute of Technology R.O.C., 1977

Master of Science in Electrical Engineering - September 1990

Advisor: C. H. Lee - Department of Electrical and Computer Engineering

The purpose of this research is to study the Hough transform method, as applied to the detection of tracks of underwater moving objects in Lofargrams. The subjects included are the Hough transformation, clustering study, and reconstruction. Two methods, LAS cluster technique and Sorting, are used for cluster analysis. Encouraging results are obtained from the Sorting method. A further improvement of the Sorting is shown to yield better results in processing noisy track data. Experimental results dealing with noise free artificial data, noisy artificial data, and real noisy data are presented. The improved Sorting technique presented in the thesis has shown improvements compared to the straight forward Sorting when it is applied to spectral component tracking.

TRUNCATED SUM MVL MINIMIZATION USING THE NEIGHBORHOOD DECOUPLING ALGORITHM

Yao-Ming Wang - Captain, Taiwan Republic of China Army

B.S., E.E., Chung Cheng Institute of Technology, 1982

Master of Science in Electrical Engineering - December 1989

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

Several heuristics have been developed for the multiple-valued logic minimization problem, and while each claims some advantages in specific examples, none is significantly better than the others. Heuristic methods are interesting because exact minimization methods are extremely time-consuming. With the computer software developed at NPS called HAMLET, users can easily investigate their own heuristics. The primary goal of this thesis is to develop an algorithm that makes the minimization of multiple-valued logic functions reasonably close to the optimal solution. The neighborhood decoupling (ND) algorithm is built on top of HAMLET. The idea of the ND algorithm is: always select the most isolated minterm as well as choose the most isolated implicant. In this thesis, the implementation of the ND algorithm is described. A performance analysis of the ND algorithm is presented by comparing results and computation time with two published algorithms, Pomper and Armstrong's and Dueck and Miller's.

THE USE OF SEARCHING ALGORITHMS FOR THE MINIMIZATION OF MULTI-VALUED LOGIC FUNCTIONS

Alan W. Watts - Captain, United States Army

B.S., United States Military Academy, 1979

Master of Science in Electrical Engineering - June 1990

Advisor: J. T. Butler - Department of Electrical and Computer Engineering

The goal of this thesis was to develop a searching algorithm for simplifying Multi-Valued Logic (MVL) functions. The algorithm was implemented as a program written in C for the UNIX operating system. The algorithm accepts and MVL function in the format required by HAMLET, and MVL computer-aided design tool, and produces a minimal or near-minimal realization. The output also conforms to that required by HAMLET to produce a layout of a programmable logic array (PLA) integrated circuit that realizes the given function. The advantage of the algorithm is that it allows backtracking to investigate alternate solutions, producing a greater expectation of minimal results. It stops upon finding a solution, thus producing results much faster than an exhaustive search of all possible solutions.

MULTIDIMENSIONAL SPECTRAL ESTIMATION USING ITERATIVE METHODS

Roderick C. Wester - Lieutenant, United States Navy

B.S.M.E., Massachusetts Institute of Technology, 1984

Master of Science in Electrical Engineering - June 1990

Advisor: C. W. Therrien - Department of Electrical and Computer Engineering

This thesis treats the topic of multidimensional autoregressive (AR) spectral estimation. An iterative algorithm for the solution of toeplitz block-toeplitz matrix equations is presented. This leads to a fast solution of the 2-D normal equation compared with direct inversion of the autocorrelation matrix. The covariance method is used to estimate the autocorrelation function. Because the resulting autocorrelation matrix is not toeplitz block-toeplitz, a modified iterative algorithm is presented. Quarter-plane (QP) and nonsymmetric half-plane (NSHP) support are used, as well as combined quadrant (CQ) averaging. Results of computer simulation show that in some cases a single iteration is sufficient to produce an acceptable spectral estimate. Because the AR parameters are estimated from previous values, this suggests the possibility to estimate spectral densities of slowly varying random processes.

**REAL-TIME IMPLEMENTATION OF AN ADAPTIVE DEPTH CONTROLLER
FOR A SUBMERSIBLE**

**James M. Williams - Lieutenant, United States Navy
B.O.E., University of Mississippi, 1983**

Master of Science in Electrical Engineering - December 1989

Advisor: R. Cristi - Department of Electrical and Computer Engineering

An Autonomous Underwater Vehicle (AUV) is an unmanned submersible vehicle capable of performing a variety of missions. The AUV, which is the subject of this research, is a small prototype vehicle equipped with various control surfaces as well as telemetry devices which provide pertinent measurements of the vehicle states. This research is directed toward the development and implementation of a digital control program which provides robust depth control of the vehicle. An adaptive parameter estimation routine is used to develop the model of the relationship between the actuator commands and vehicle response. State feedback is then provided using a variable structure approach. The control algorithm has been implemented through a Turbo Pascal digital control program executed on a PC/AT computer. Results of the parameter estimation routine and controller implementation are discussed.

**THE PORTING OF A MAINFRAME-DEPENDENT ANTENNA MODELING
PROGRAM (NEC-3) TO A 32-BIT PERSONAL COMPUTER**

**James Jay Wright - Lieutenant, United States Navy
B.S. United States Navy**

B.S., United States Naval Academy, 1983

Master of Science in Electrical Engineering - June 1990

Advisor: R. W. Adler - Department of Electrical and Computer Engineering

The purpose of this research was to demonstrate the feasibility of porting a large mainframe-dependent scientific FORTRAN program, specifically the Numerical Electromagnetics Code (NEC-3) to a 32-bit personal computer. Two systems, an AST Premium 386/33 with both Intel 80837 and Weitek w3167 math co-processors, were used with several 32-bit FORTRAN 77 compilers. Results show that when NEC-3 was promoted to full double precision, complete accuracy was maintained while suffering only a 12% increase in execution time over single precision. Testing also revealed that the double precision Weitek version is 30% faster than the 80837 version. Some small inaccuracies remain; however, the same results were obtained by both the Naval Postgraduate mainframe's new IBM VS2 FORTRAN 77 compiler and the personal computer FORTRAN 77 compilers. This indicates that the "bug" is in the NEC-3 code, vice being a hardware or FORTRAN 77 compiler problem.

AN ANALYSIS OF MLAYER: A MULTILAYER TROPOSPHERIC PROPAGATION PROGRAM

**Lean-Weng Yeoh - Ministry of Defense, Singapore
B.ENG.(Hons), National University of Singapore, 1983
MSc(EE), National University of Singapore, 1987**

Master of Science in Electrical Engineering & Electrical Engineer - June 1990

Advisor: H. M. Lee - Department of Electrical and Computer Engineering

MLAYER, a computer program, was developed by the Naval Ocean Systems Center (NOSC) for calculating the signal levels of electromagnetic waves propagating in a multilayer tropospheric waveguide environment over seawater. The program is an extension of the XWVG which is a trilinear ducting program. Modifications of the XWVG were carried out to handle multilayer tropospheric ducts. A number of modifications and improvements on the program made over the past several years were not documented. A detailed documentation of MLAYER was also not available. The objective of this study is to develop a technical documentation for MLAYER using the program as baseline. The study aims to put together the theoretical formulations (specific to MLAYER) into a complete self-contained document. This is to facilitate potential users with better appreciation of the capabilities, limitations, approximations and assumptions used in the mathematical modelling techniques. As far as possible, the same terminologies and functional variables used by Baumgartner (in the XWVG development) and by Pappert (in the MLAYER development) are adopted to enable one to relate this document to the program. Step-by-step derivation of certain equations was carried out and checked for compatibility with the algorithm in the program. An in-depth scrutiny of each program element was also conducted and a description for each is provided. As a result of a detailed analysis of the respective algorithm in the program, the documentation for the evaluation of the modal function was eventually prepared. Additional materials were gathered from technical reports and papers to supplement the development of this document. The MLAYER supporting programs (Microsoft program maintenance utility "makefiles") were modified to enable the program to run on Microsoft FORTRAN version 5.0. MLAYER was tested and ran successfully on Microsoft FORTRAN version 5.0. and C compilers version 5.0.

ON THE DESIGN AND ANALYSIS OF MULTIPLE-VALUED STORAGE ELEMENTS

**David A. York - Lieutenant, United States Navy
B.S., University of Missouri, 1981**

Master of Science in Electrical Engineering - December 1989

Advisor: J. T. Butler - Department of Electrical and Computer Engineering

The primary contribution of this thesis is the development of a data storage latch that accepts, stores and provides four-valued logic signals. The latch is implemented in CMOS and all logic levels are encoded as voltage. The latch storage state is determined by thresholding operations on its unput, and the output is a logically restored replica of that (multiple-valued) input. Detailed analysis of an existing current-mode CMOS design is also presented in this study. A comparison between these devices reveals that the voltage-mode data latch provides less stable intermediate logic states, but consumes significantly less static power. In addition, the voltage-mode CMOS design can be implemented with the same number of devices that are required for two binary "D" flip-flops.

RECOGNITION OF VLSI MODULE ISOMORPHISM

**Emmanouil N. Zagourakis - Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1980**

Master of Science in Electrical Engineering - March 1990

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

The purpose of this study was to determine whether or not a program can be developed to examine isomorphism between parts of a VLSI layout. Many simulation files, obtained through Magic's hierarchical extractor, were analyzed in order to develop a C program to accomplish recognition of several types of gates. This recognition gives signatures in order to check for isomorphism. The development and design of the algorithms used in different parts of the program are described. Results demonstrate that recognition of elements in a CMOS circuit is possible, even with moderate complexity structures. An appendix with the C program listings is included.

**MASTER OF SCIENCE
IN
ENGINEERING
ACOUSTICS**

BUBBLE PRODUCTION BY BREAKING WAVES

Albert C. Daniel Jr. - Lieutenant, United States Navy

B.S., University of South Carolina, 1984

Master of Science in Engineering Acoustics - December 1989

Advisor: H. Medwin - Engineering Acoustics Academic Committee

It has been shown (Medwin and Beaky, J. Acoust. Soc. Am., v. 86, 1124-1130 (1989)) that spilling breakers in the laboratory produce a sound close to the Knudsen sea surface noise spectrum from 400 Hz to 20 kHz. The surface spectral production density of newly-created near surface bubbles under these laboratory spilling breakers has now been acoustically determined by using an array of hydrophones. The surface spectral density has been obtained by identifying the individual bubbles that create this noise spectrum. The radii were calculated from the resonance frequencies. The bubble positions on the surface of the water were determined from the difference in time of arrival of the bubble radiation to the elements of two vertical arrays of hydrophones. The production area and rate of production of bubbles of radii 0.048 to 7.40 millimeters have been calculated and the total volume of air encapsulated into bubble foam per unit area of spilling breakers has been determined.

ON THE USE OF SYMPATHETIC RESONATORS TO IMPROVE LOW FREQUENCY TRANSDUCER PERFORMANCE

John Merle Ellsworth - Lieutenant, United States Navy

B.E., State University of New York, Stony Brook, 1983

Master of Science in Applied Science and Engineering Acoustics

September 1990

Advisor: S. R. Baker - Department of Physics

The achievable gain in the radiation resistance and directivity of a low frequency underwater transducer due to the presence of an array of sympathetic resonators was analyzed. The resonators were all taken to be air bubbles, and both the resonators and transducer were taken to be compact ($ka \ll 1$). The resonators were taken to be equally spaced around a circle of radius R , with the transducer located on the axis. The gain was calculated for various numbers of resonators as a function of ka resonator, ka transducer and kR , for the transducer in the plane of the resonators and out of the plane a distance of one-quarter wavelength. For the transducer in the plane, a gain in radiation resistance of approximately two is possible with six or more resonators. For the transducer out of the plane, it is shown that a significant gain in directivity can be achieved at the expense of a slight decrease in the gain in the radiation resistance.

OCEANOGRAPHIC AND ACOUSTICAL SURVEY OF THE EAST IONIAN SEA

Radamanthis P. Fountoulakis - Lieutenant, Hellenic Navy

B.S., Hellenic Naval Academy

Master of Science in Engineering Acoustics - September 1990

Advisors: R. H. Bourke & A. B. Coppens - Engineering Acoustics

Academic Committee

A study was conducted in an area off the Hellenic west coast to examine the spatial and time variability of various oceanic parameters, with special emphasis on those effecting ASW operations. Propagation loss runs were conducted using PE and RAYMODE models. The reactions of both models to different bottom morphology and sound speed profiles (seasons) were examined. Between the two models, the PE model was found to be closer to reality than RAYMODE. Results suggest that the application of these models can improve the understanding of sound propagation in the Hellenic seas. The bottom modeling program, BLUG, appears to need improvement.

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

David Anthony Harris - Captain, Canadian Air Force

B.S., Royal Roads Military College, 1981

Master of Science in Engineering Acoustics - June 1989

and

Richard Eugene Volkert - Lieutenant, United States Navy

B.A.E., Auburn University, 1982

Master of Science in Engineering Acoustics - December 1989

Advisor: T. J. Hofter - 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 electronics 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.

**UNDERWATER SOUND RADIATED BY IMPACTS AND BUBBLES CREATED
BY RAINDROPS**

Armagan Kurgan - LTJG, Turkish Navy

B.S., Naval Academy, Istanbul, 1983

Master of Science in Engineering Acoustics - December 1989

Advisors: H. Medwin & J. Nystuen - Engineering Acoustics Academic

The sound generated by rainfall at sea is caused by raindrops of a wide range of sizes and angles of incidence, which fall at their terminal velocities. The purpose of this laboratory research has been to make complete acoustical measurements of the sound generated by single water drops striking the water surface at their terminal velocities for normal and oblique incidence. These measurements have included the total acoustic energy, peak axial pressure, frequency spectrum and polar radiation pattern. Depending on the drop size and the angle of incidence, many drops falling at their terminal velocities create bubbles. At all angles of incidence studied here the sound radiated by an individual bubble contains more energy than the sound from an individual impact. These results, using terminal velocities and oblique trajectories, are very different from the published normal incidence, non-terminal velocity characterizations. For example bubble frequencies other than the well known 14 kHz peak are found. Also the energy of the impact sound increases significantly for larger drop sizes and for larger deviations from normal trajectories. Furthermore, drops of diameter 0.8 mm to 1mm, which always produce bubbles at normal incidence, create bubbles only about 10% of the impacts at oblique incidence. These observations provide specific reasons for the previously unexplained broadening, shifting and reduction in magnitude of the 14 kHz spectral peak of the rain noise in the presence of winds at sea.

INVESTIGATION OF A HEAT DRIVEN THERMOACOUSTIC PRIME MOVER

Hsiao-Tseng Lin - Captain, Taiwan, Army

B.S., Chung Cheng Institute of Technology in Taiwan, 1984

Master of Science in Engineering Acoustics - December 1989

Advisor: A. A. Atchley - Department of Physics

The goal of this thesis is to investigate the work output of a heat driven thermoacoustic prime mover. The experimental approach was to measure the frequency response of both a simple resonant tube and a prime mover for a variety of values of mean gas pressure and applied temperature difference across the prime mover stack. A least squares fit to the frequency response yields the quality factor which can be compared to predictions based on a short stack, boundary layer approximation theory by Swift [J. Acoust. Soc. Am. 84, 1145-1180 (1988)]. The results are reported of measurements made on the lowest three modes of the prime mover in helium for mean gas pressures between approximately 170 kPa and 500 kPa and the applied temperature differences between zero and onset. The signal waveforms of the sound generated by the prime mover above onset at a mean gas pressure of 308 kPa are also reported. Results for the resonant tube have at most 3% difference with theory. For the prime mover, the measurements generally agree with predictions for the fundamental mode except close to onset. This agreement between measured and predicted results worsens with decreasing mean gas pressure. Agreement is poor for the second and third modes for all pressures used. Finally, the sound generated by the prime mover above onset is highly distorted, and the distortion becomes more serve as the temperature difference increases. The peak positive pressure amplitude of this signal at temperature difference of 325°C, 368°C and 453°C are 1.1%, 4.4% and 7.9% of mean gas pressure, respectively.

APPARATUS TO DETERMINE THE COMPLEX MASS OF A VISCOUS FLUID CONTAINED IN A RIGID POROUS SOLID FROM ACOUSTING PRESSURE MEASUREMENTS

Robert Allen Mirick - Lieutenant Commander, United States Navy

B.S., United States Naval Academy, 1979

Master of Science in Engineering Acoustics - December 1989

Co-Advisors: S. R. Baker & O. B. Wilson - Department of Physics

Two experimental techniques to determine the frequency dependent complex mass of a viscous fluid contained in a rigid porous solid are investigated. In one technique the moving mass of the fluid is sensed by its effect on the measured input electrical impedance of a moving coil transducer. In the second technique the moving mass is extracted from the measured acoustic pressure required for the fluid to oscillate with a known amplitude through the solid frame. A description of the apparatus and preliminary results using the pressure method as well as a comparison of the two techniques are presented.

MATCHED-FIELD PROCESSING FOR UNDERWATER SOURCE LOCATION

David D. Pierce - Lieutenant, United States Navy

B.S., University of Rochester, 1983

Master of Science in Engineering Acoustics - December 1989

**Advisors: C. W. Therrien & J. H. Miller - Department of
Electrical Engineering**

Matched-field Processing is a generalization of plane-wave beamforming which allows localization of an underwater acoustic source in range and depth. Four Matched-field Processing algorithms-the Bartlett, Minimum-variance, Linear Prediction, and MUSIC methods-are compared, via numerical simulation, with regard to: 1) their resolution; 2) their performance in high-noise environments; and 3) their sensitivity to modeling errors. The Linear Prediction method was plagued by spurious peaks for all realistic noise levels. The Bartlett, Minimum-variance, and MUSIC methods showed approximately equal sensitivity to errors in knowledge of the sound speed profile. However, the MUSIC method, which has received little attention in Matched-field Processing applications, provided greater resolution and greater resistance to noise than either the Bartlett or Minimum- variance methods.

**DEVELOPMENT OF A LABORATORY FACILITY FOR THE MEASUREMENT
OF SOUND PROPAGATION IN SHALLOW WATER ENVIRONMENT**

Nakorn Pongsitanont - Commander, Royal Thai Navy

B.S., Royal Thai Navy Academy, 1975

Master of Science in Engineering Acoustics - December 1989

Advisor: J. V. Sanders - Department of Physics

The propagation of sound in a laboratory-modeled, shallow water environment consisting of water overlying a thick layer of water-saturated sand was experimentally investigated. A hydrophone consisting of a small lead titanate lead zirconate cylinder was used as a receiver. A 304 x 117 x 95 cm fiberglass-encased wooden tank with 10 cm of water 45 cm of water-saturated sand of density 2053 kg/m³ was used in this experiment. The receiver sensitivity and directionality were determined for frequencies from 10 kHz to 100 kHz. The ratio of the speed of sound in the water-sand to that in water was 1.2. The measured normal-incident pressure reflection coefficient were within 12.8% of the predicted values. The measurements of pressure amplitude in the water as a function of depth were found to be in good agreement with normal mode theory for the first mode, but slightly unexplained differences were observed for the sum of the first and second mode. The apparatus developed for this thesis has been shown to accurately model sound propagation in shallow water with flat bottom sediments. And is now available for the study of more complicated bottom topographies.

**MASTER OF SCIENCE
IN
ENGINEERING
SCIENCE**

MAPPING THE AIRWAKE OF A MODEL DD-963 ALONG SPECIFIC FLIGHT PATHS

Gustav Andrew Anderson - Lieutenant, United States Navy

B.S., United States Naval Academy, 1982

Master of Science in Engineering Science - December 1989

Advisor: J. Val Healey - Department of Aeronautics and Astronautics

This study is a continuation from the flow visualization studies done in the NPS low-speed environmental wind tunnel. The long term goal is to map the airwake around a ship model and scale to full size for the purpose of determining safe operating envelopes on non-aviation ships. This project utilized hot wire and hot film anemometry to establish a data base for helicopter approach paths at 0°, 30° port, and 30° starboard ship yaw angles. Calibration of the wind tunnel revealed that some turbulence generators, used in the previous two studies, created excessive turbulence intensity levels and were subsequently removed. Analysis along the flight paths was done with and without the model in place. The comparison showed that turbulence intensity levels of up to 50% were experienced in the proximity of the flight deck. These levels fell by 40 to 50% within ¼ ship length along all approach paths. The starboard yaw approach path contained the greatest turbulence magnitudes and the 0° yaw contained the least.

NEAR-STALL LOSS MEASUREMENTS IN A CD COMPRESSOR CASCADE WITH EXPLORATORY LEADING EDGE FLOW CONTROL

J. H. Armstrong - Lieutenant, United States Navy

B.S., United States Naval Academy, 1983

Master of Science in Engineering Science - June 1990

Advisor: R. P. Shreeve - Department of Aeronautics

Loss measurements were conducted using a five hole conical pneumatic probe in a subsonic wind tunnel containing a modeled cascade of controlled diffusion (CD) stator blades. Following reference measurements at high incidence one blade was modified (slotted at the leading edge) in an attempt to (passively) reduce the size of the leading edge separation bubble and thereby improve performance. Prior to the surveys, the acquisition and reduction software was modified to provide loss calculations using both mass-averaged and fully-mixed-out conditions for the upstream and downstream flows. Results showed that the mass-averaged method provided the more consistent results, and this was explained. The slotted leading edge blade was found to produce less loss than the reference blade, and it was concluded that the control concept should be explored in more detail.

AN EXPERIMENTAL INVESTIGATION OF STRAND BURNING METALLIZED SOLID PROPELLANTS

Kevin J. Arnold - Captain, United States Army

B.S., United States Military Academy, 1979

Master of Science in Engineering Science - December 1989

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

Characteristics of the products of combustion of metalized solid propellant strands at pressures between 250 and 750 psi were investigated using holography and light scattering measurements. In addition, scanning electron microscope and light scattering measurements were used to examine quenched residue. A reduced smoke ZrC propellant and three propellants of varying aluminum loading (2%, 4.8%, and 16%) were examined. The objective of the experiments was to provide sufficient particle data from strand burners to make it possible to determine if any correlation of results from this method of analysis could be made with results from other more complex solid propellant motor measurements, such as plume probe and signature measurements. The results of these efforts reflected the inability of any single technique of analysis to completely describe particle size distributions. These results also suggest the need for modification of current experimental apparatus and procedures.

**THE COMPUTER SIMULATION AND MODELING OF A FLEXIBLE MISSILE
IN 2-D MOTION**

**Mehmet Aysel - Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1982**

Master of Science in Engineering Science - December 1989

Advisor: L. W. Chang - Department of Mechanical Engineering

The main goal of this research is to model a flexible missile with structural flexibility utilizing the Equivalent Rigid Link System (ERLS) with an enhanced natural mode discretization. Dynamic analysis of the flexible missile in 2-Dimension motion is presented. Computer simulation is performed where the pitch angle of the missile is controlled with a rigid-body controller. The effects of increasing payloads and speed to the system performance are discussed.

THE DESIGN AND CONSTRUCTION OF A SHIPLAUNCHED VTOL UNMANNED AIR VEHICLE

**Bryan M. Blanchette - Lieutenant, United States Navy
B.A., University of Washington, 1982**

Master of Science in Engineering Science - June 1990

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

A Vertical Takeoff and Landing (VTOL) Unmanned Air Vehicle (UAV) was designed to serve as a shiplaunched reconnaissance over the horizon targeting aircraft. Modeled after the U.S. Army's Aquila, the aircraft features a unique tilting ducted fan propulsion unit. The duct contains the engine, propeller, and control vanes used to provide the VTOL capability is designed to be rotated as a unit for transition into horizontal flight. The duct also provides a measure of shipboard safety by eliminating the potential propeller blade and other hazards associated with the launch and recovery cycle currently experienced by topside personnel. The advantage of using tilting ducted fan technology is it allows the vehicle to operate off of any ship and will have the dash speed to arrive on station in a timely manner. A 1/2 scale model was built using composite wet lay-up techniques as a technology demonstrator and flight test vehicle. The engine system was tested, but failed to produce enough static thrust for vertical takeoff. Research is continuing in the development of a propeller that will provide the necessary thrust.

**SIMULATION AND ANALYSIS OF A MFQPSK SIGNAL TRANSMITTED THROUGH
AN ACOUSTIC MEDIUM**

Anita S. Daniel

B.S., Northern Arizona University, 1983

Master of Science in Engineering Science - December 1989

**Advisor: P. H. Moose - Department of Electrical and
Computer Engineering**

A multi-frequency quadrature phase shift keyed (MFQPSK) signal has been developed at NPS to be used in computer-to-computer communications. This report discusses the simulation of a MFQPSK signal transmitted from a moving transmitter platform through a near vertical acoustic channel as seen by a moored receiver. The simulated received signal is tested against MFQPSK signal theory. The simulation was developed to be an experimental tool for testing various Doppler, synchronization, and coding algorithms/techniques for a MFQPSK communication signal. The degradation of output signal-to-noise ratio due to Doppler shifts caused by the moving transmitter is analyzed. An algorithm for estimating Doppler compression/expansion in the received signal is evaluated.

NONMETALLIC INCLUSIONS IN HSLA STEEL WELDMENTS

Brent Alan Douglas - Captain, United States Marine Corps

B.S., United States Naval Academy, 1981

Master of Science in Engineering Science - December 1989

Advisor: A. G. Fox - Department of Mechanical Engineering

The U.S. Navy is currently funding a program for certification of HSLA steels to replace the HY series of high strength steels for structural fabrication. Integral to this program is the certification of welding consumables for use with these steels. The size, distribution and composition of nonmetallic inclusions in HSLA steel weld metal has been shown to play a key role in the final strength and toughness of the deposited weld. The purpose of this study was to develop a procedure for analysis of nonmetallic inclusions in HSLA steel multipass weldments utilizing optical microscopy and examination and EDX analysis in a SEM. The results of the study suggest that the mean diameter of inclusions in the final pass of a GMAW weldment in a 2.0 inch HSLA-100 plate is larger than the mean diameter of those in the root pass. Additionally the material in the final pass contains a greater amount of Si and Ti deoxidation products than that in the root pass. The larger size, composition and complex structure of the inclusions in the final pass suggest that they contain deoxidation products from previous welding passes which have been released through remelting and coalesced into larger inclusions.

AEROPREDICTIVE METHODS FOR MISSILE ANALYSIS

Archibald S. Dunn - Lieutenant, United States Navy

B.A., United States Naval Academy, 1983

Master of Science in Engineering Science - December 1989

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

Various computational methods and operational computer codes used to predict and evaluate aerodynamic coefficients and flight performance of missile bodies are reviewed. Aerodynamic effects of symmetric and asymmetric flow separation are discussed, as are the differences inherent in estimating the properties of the resulting flowfields. The semi-empirical aeroprediction codes NSWC and MISSILE DATCOM are compared against experimental data for a variety of configuration geometries and flight conditions; the MISSILE DATCOM code is further used for a comparison with wind tunnel data for a Standard-type missile model. The NSWC and MISSILE DATCOM codes are found to provide accurate prediction of normal force coefficients at both low and high angle of attack, although the nonlinear effects of separated flow are only partially captured. Center of pressure coefficients are generally underpredicted, but of the correct order of magnitude. The accuracy of drag coefficient prediction is seen to diminish as missile configuration geometry becomes more complex. The NSWC program provides satisfactory prediction of pitch damping coefficients, while the MISSILE DATCOM output is inconclusive. The NSWC and MISSILE DATCOM aeroprediction codes are considered suitable for preliminary design and aerodynamic analysis.

A COMBINED OPTICAL AND COLLECTION PROBE FOR SOLID PROPELLANT EXHAUST PARTICLE ANALYSIS

Timothy James Eno - Captain, United States Army

B.S., United States Military Academy, 1980

Master of Science in Engineering Science - December 1989

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

A combined optical and collection probe for solid propellant rocket motor exhaust particle analysis was designed and utilized in initial experiments with a sub-scale rocket motor. Shock swallowing capabilities of the probe were verified under restricted motor operations using a schlieren system. Window purge and ejector design were shown to be capable of keeping the probe windows clean when the probe was placed approximately 14 nozzle diameters downstream of the exhaust nozzle. The exhaust plume deflection device allowed sampling to occur during the minimum time required to reach steady flow within the probe. A MALVERN Mastersizer was used for in situ measurements of the particles, and a collection filter at the aft end of the probe was partially successful in capturing the probe flow. Suggestions are made for probe improvements and future investigations.

CW PROJECTILE TRACKING RANGE ANALYSIS
Yen-Chun Feng - Lieutenant Colonel, Taiwan Army
B.S., Chung-Cheng Institute of Technology, 1974
Master of Science in Engineering Science - December 1989
Advisor: H. M. Lee - Department of Electrical and
Computer Engineering

The conventional low-power CW doppler projectile tracking radar is investigated through simulation. The power requirement for full range tracking with real-time track data processing stopped within 160 m of the point of impact is obtained. This power can be lowered by a factor of more than 4 if a set of three switchable filters is utilized.

THE STRESS AND TEMPERATURE DEPENDENCE OF CREEP IN
AN Al-2.0WT%LI ALLOY

Earl F. Goodson, Sr. - Lieutenant, United States Navy
B.S., United States Naval Academy, 1982
Master of Science in Engineering Science - December 1989
Advisor: T. R. McNelley - Department of Mechanical Engineering

The effect of stress and temperature on the creep behavior of an Al-2.0wt%.Li alloy was investigated in the temperature range from 300 to 500°C. This temperature interval corresponds to a solid solution of Li in Al. Experimental results indicate that Al-2.0wt%Li behaves as a pure metal class alloy (class II). This is demonstrated by several creep characteristics including the value of the stress exponent ($n \sim 5$), the shape of the creep curve, and the nature of the creep transient after a temperature change. However, anomalous behavior of the activation energy was observed. Activation energies up to 55 kcal/mole, decreasing to approximately 33 kcal/mole at higher temperatures, were observed by the temperature cycling technique.

THE ROLES OF STRAIN AND REHEATING INTERVAL IN CONTINUOUS
RECRYSTALLIZATION DURING THE THERMOMECHANICAL PROCESSING
BY WARM ROLLING OF AN Al-MG ALLOY

Thomas Edwin Gorsuch - Lieutenant Commander, United States Navy
B.S.N.E., University of Virginia, 1976
Master of Science in Engineering Science - December 1989
Advisor: T. R. McNelley - Department of Mechanical Engineering

Investigation into the influence of rolling strain and into the variation of properties and structure during reheating intervals between rolling passes in the thermomechanical processing of an Al-9.89Mg-0.09Zr alloy (composition in weight percent) was conducted. Superplastic ductilities up to approximately 1120 percent were achieved by processing to a total strain of 2.5 utilizing a reheating interval of 30 minutes. Conversely, rolling to lesser values of strain with the same reheating interval or rolling to a strain 2.5 and using a 5 minute reheating interval produced ductilities less than 400 percent. A strong correlation was demonstrated between results achieved and a qualitative model for continuous recrystallization during thermomechanical processing previously proposed.

SEPARATING BOUNDARY LAYER RESPONSE TO AN UNSTEADY TURBULENT ENVIRONMENT

David J. Gwilliam Jr. - Lieutenant, United States Navy

B.S., United States Naval Academy, 1983

Master of Science in Engineering Science - December 1989

Advisor: R. M. Howard - Department of Aeronautics and Astronautics

An experimental investigation of the separating boundary layer of a wing subjected to periodic turbulent disturbances was conducted. Turbulence pulses were generated by a non-thrusting spinning rod placed upstream of the test airfoil at the reduced frequencies of .09 and .47. Time-varying velocity measurements were made at various heights above the 70% chord location at 12 degrees angle of attack (nearly separated flow) and 22 degrees angle of attack (fully separated flow). Split-film anemometry was used to determine flow speed and direction. The flow responses were compared to the quasi-steady state of undisturbed separated flow. Variation of reduced frequency had a dramatic influence on the effects which the periodic disturbance had on the flow response. At a reduced frequency of .47 the periodic disturbance had no noticeable influence. Imposition of periodic disturbance of the same reduced frequency on attached flow near separation (12 degrees angle of attack) once again caused no apparent destabilizing effects. The lack of sensitivity of the separated boundary layer to the pulses generated at the higher reduced frequency of .47 apparently resulted from its inability to resolve turbulent pulses from one another. Imposition at 22 degrees angle of attack of a pulse at the reduced frequency of .09, however, first stabilized the flow, then greatly intensified the original separation before allowing the flow to return to its undisturbed separated state.

APPLICATION OF H_∞ METHOD TO MODERN FIGHTER CONFIGURATION

Ta-Chieh Hsu - Captain, Republic of China on Taiwan Army

B.S., Chung-Cheng Institute of Technology, 1983

Master of Science in Engineering Science - December 1989

Advisor: D. J. Collins - Department of Aeronautics and Astronautics

H_∞ optimal control theory, based on singular value loop shaping, is used to synthesize a controller for the statically unstable longitudinal dynamics of X-29 aircraft. Two design cases are studied: 2-input 2-output; and 3-input and 3-output cases. H_∞ theory provides a direct, effective procedure for synthesizing control laws satisfying specified performance objectives and robustness specifications. The 2 I/O case has better performance, a faster response and is more robust, than the 3 I/O case. Discussion and comparison of results are given.

A KALMAN FILTER WITH SMOOTHING FOR HURRICANE TRACKING AND PREDICTION

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B.S.E.E., Turkish Naval Academy, 1983

Master of Science in Engineering Science - December 1989

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

The performance of a Kalman filter used to track a hurricane was substantially improved by implementing a fixed interval smoothing algorithm. This tracking routine was designed and implemented in a microcomputer program. Several tracking scenarios were simulated and analyzed. Actual storm tracks obtained from the Joint Typhoon Warning Center in Guam, Mariana Islands, were used for this research. The application of the Kalman tracker to a tropical storm's wind speed tracking was also investigated by using the best track data and observed data.

FLOW MODIFICATION OVER A BACKWARD FACING STEP
Marshall L. Narveson - Lieutenant Commander, United States Navy
B.S., University of Wisconsin - Madison, 1978
Master of Science in Engineering Science - September 1990
Advisor: J. Val Healey - Department of Aeronautics and Astronautics

The Naval Postgraduate School (NPS) has undertaken a series of studies on ship air wake tailoring, through the use of deflectors, with the goal of reducing the level of turbulence and the size of the separated zones on the helicopter deck. This reduction will result in a larger engage/disengage envelope, which in turn, will increase the percentage of time that the H-46 and other helicopters can safely operate. This study is the second in the series at NPS to attempt to achieve this goal and considers only the feasibility of tailoring a two-dimensional flow over a backward facing step. Nonporous flat and curved deflectors and porous flat deflectors were mounted in various positions near the edge of the step and the flow patterns recorded using both still and video photography. The deflectors were mounted at varying separations from the step and varying angles to the vertical. It was found that the porous deflectors produced the lowest velocities in the region behind the step, and the nonporous produced the greatest changes in the flow pattern. The results were also compared to the results of the first study that used the "PHOENICS" computational fluid dynamics program. With one exception, the results differed only by the underprediction of the length of the horizontal flow pattern.

EFFECTS OF FLOWFIELD TURBULENCE ON ASYMMETRIC VORTICES
OVER A SLENDER BODY

James Alan Pinaire, Jr. - Lieutenant, United States Navy
B.S., Indiana Central University, 1982
Master of Science in Engineering Science - December 1989
Advisor: R. M. Howard - Department of Aeronautics and 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 1.1×10^5 was investigated in a low-speed wind tunnel at the Naval Postgraduate School. The location and intensity of the asymmetric vortices in the wake of the missile model were determined and the vortices were displayed using planar velocity vector, total pressure coefficient, and vorticity plots. The model configuration tested was a body-only configuration (wings, strakes, and tails removed). Two flowfield conditions were treated: the nominal ambient wind tunnel condition and a grid-generated turbulence condition. Flow visualization was conducted and video-taped for both the body-only configuration and the winged configurations. The following conclusions were reached: 1) the addition of turbulence decreased the vorticity but did not significantly change the patterns of the plots; 2) the addition of turbulence reduced the vorticity more at eleven body diameters than at six body diameters; 3) compared to the body-only case, the vorticity is reduced for the "X" case but not for the "+" case for the turbulence condition; 4) flow visualization verified vortices movement away from the missile as the tested point was moved aft along the missile body.

**A STUDY OF 3-D VISUALIZATION AND KNOWLEDGE-BASED MISSION PLANNING
AND CONTROL FOR THE NPS MODEL 2 AUTONOMOUS UNDERWATER VEHICLE**

Ray Charles Rogers - Lieutenant Commander, United States Navy

B.S., Southern University and A & M College, 1978

Master of Science in Engineering Science - December 1989

Advisor: R. B. McGhee - Department of Computer Science

Recently, specific tasking/total military mission concepts for subsea tasks have been developed that demand substantially more endurance and range than can be provided by manned submersibles and Remotely Operated Vehicles (ROVs), respectively. Small, autonomous unmanned systems can provide the best combination of speed, endurance, range, depth capacity, and flexibility needed to make these concepts realizable. As the U.S. Military has continued to identify more and more tasks that can be performed by autonomous systems, the Naval Postgraduate School has heightened its research efforts to develop an experimental autonomous underwater vehicle (AUV) to address these military requirements. As part of this development process, a series of NPS AUV simulation systems have been developed that couple knowledge-based mission planning and control systems with 3-D visualization (graphics) workstations that communicate across an interprocess communications network. Development of these simulation systems have produced an extremely useful "laboratory environment" for rapid prototyping of AUV planning, navigation, and control subsystems software. This thesis updates and extends the formats and functionality of the simulation systems to include a Mission Planning and Control Workstation as a prototype for use aboard AUV deployment vessels, upgrades mission profiles, and incorporates improvements to the software interface between the mission planning and control subsystem and the 3-D visualization subsystem.

**DEVELOPING PORTABLE USER INTERFACES FOR ADA COMMAND
CONTROL SOFTWARE**

Chien Hsiung Sun - Lieutenant Commander, Taiwan Navy

B.S., Taiwan Naval Academy, 1979

Master of Science in Engineering Science - June 1990

Advisor: L. Luqi - Department of Computer Science

DoD mandated use of Ada for embedded systems includes Combat and Control System such as shipboard Combat Direction System (CDS). A Low Cost CDS (LCCDS) which will use commercial workstation platforms will require interfacing Ada real-time programs with a portable windowing environment such as X Windows. This thesis explores several methods for building X Windows based user interface for Ada C² programs and provides a step-by-step approach to user interface design for future CDS developers.

CONTROL OF FLOW OVER A BACKWARD FACING STEP

Scott G. Woolman - Lieutenant, United States Coast Guard

B.S., University of California at Davis, 1979

Master of Science in Engineering Science - September 1990

Advisor: J. Val Healey - Department of Aeronautics and Astronautics

The poor aerodynamic design of the superstructures of today's Navy ships create a highly turbulent airwake that can make shipboard helicopter operations quite hazardous. This study is part of a longer-term project to tailor airflow over a ship's helicopter deck in order to improve the poor quality of the airflow. This airflow is thought to be largely responsible for several costly blade strike mishaps involving H-46 helicopters during start-up and shut-down. Numerous computer simulations were conducted using the "Phoenix" Computational Fluid Dynamics code to simulate airflow over a backward-facing-step. The latter represents a simple 2-d model of flow behind a typical hangar/flight deck combination. In each run a deflector of different size, orientation or porosity was placed in a specific location in an attempt to reduce the size of the turbulence levels. Of the studies involved, a vertical deflector offset downstream with its lower edge at the top of the step produced the best overall results.

**MASTER OF SCIENCE
IN
HYDROGRAPHIC
SCIENCE**

AUTOMATIC SATELLITE IMAGE NAVIGATION
Brian C. Spaulding - Cartographer, Defense Mapping Agency
B.S., University of North Carolina at Wilmington, 1984
Master of Science in Hydrographic Science - September 1990
Advisor: C. H. Wash - Department of Meteorology

The satellite image navigation system for AVHRR (Advanced Very High Resolution Radiometer) imagery at the Naval Postgraduate School, referred to as Avian, has been modified from an operator interactive procedure to an automatic navigation procedure. The interactive procedure, based on operator identification of discrete landmarks, has been replaced with a procedure which utilizes the Defense Mapping Agency's (DMA) World Vector Shoreline (WVS) as a reference. Binary shoreline images are created from the satellite images and correlated with the WVS reference shoreline using a sum of absolute differences matching technique. The correlation is performed using reference and search windows selected from full resolution sub-scenes of the WVS and satellite image. Ten images were navigated with resulting accuracies of approximately 1.3 km. The resultant earth location was at least as accurate as the original Avian and did not depend upon expertise of the operator, as the original Avian procedure does. Thus, the automatic Avian procedure eliminated the subjectivity inherent in the interactive landmarking, while reducing the amount of expertise required to perform the navigation task. The automatic Avian procedure does not need a landmark atlas, so image navigation can be done globally since the World Vector Shoreline database has worldwide coverage. Currently, the only subjective and interactive step remaining is the placement of the reference and search windows to be correlated within sub-scenes. This step can be completed by an operator with no previous experience and not effect the accuracy of the navigation.

**ESTABLISHING A GPS-BASELINE BETWEEN SEATTLE, WASHINGTON AND
MONTEREY, CALIFORNIA**

James E. Waddell, Jr. - Lieutenant, NOAA Corps
B.S., University of Wisconsin-Madison, 1981
Master of Science in Hydrographic Science - December 1989
Co-Advisors: S. P. Tucker - Department of Oceanography &
N. K. Saxena - Department of Civil Engineering, University of
Hawaii at Manoa

A baseline of about 1200 km between Seattle, Washington, and Monterey, California, was measured repeatedly over a six-month period using five-channel, single-frequency Global Positioning System (GPS) receivers with carrier phase differencing techniques and broadcast ephemeris. The averaged GPS baseline length compared favorably with the length determined from control points established by Very Long Baseline Interferometry (VLBI), the agreement being on the order of 0.01 ppm (1 cm in 1200 km) which is about the precision expected of the VLBI technique itself. The quality of the agreement is startling, considering the relatively poorer precision (about 1 ppm) expected for the GPS receivers and techniques employed. To achieve this agreement, GPS observations varying more than 1 ppm from the computed mean length were discarded, and a scale factor of -0.2 ppm for the transformation from GPS to VLBI reference frames was applied, which had been estimated from other studies. The results suggest that accuracies of better than a decimeter are achievable over lines of 1000 km using single-frequency GPS equipment.

DETERMINATION OF TIDE HEIGHTS FROM AIRBORNE BATHYMETRIC DATA

Kenneth E. Welker

B.S., Southampton College of Long Island University, 1975

Master of Science in Hydrographic Science - December 1989

Advisor: J. Hannah - Department of Oceanography

Airborne Bathymetric Systems are currently under development by the U.S. Army Corps of Engineers, the Canadian Hydrographic Service, and the Royal Australian Navy. Once fully developed, the U.S. Naval Oceanographic Office (NAVOCEANO) plans to use this survey technology. NAVOCEANO faces a unique problem in utilizing airborne bathymetry, in that it plans to survey in remote and undeveloped areas of the world where tide control obtained through tide gauge deployment is often logistically and economically prohibitive. This thesis offers a method for significantly reducing the number of tide gauges needed for tide control in such a survey when the survey is conducted in an open coast environment. The approach given here provides a method for delineating a tidal zone and then suggests a survey scenario which will allow the isolation of the major components of the tidal signal through a least squares adjustment. A proof of concept simulation model developed in the thesis results in tidal depth reducers which more than satisfy IHO specifications.

**MASTER OF SCIENCE
IN
INFORMATION
SYSTEMS**

**IMPLEMENTATION OF A DISTRIBUTED EXPERT SYSTEM FOR SUBMARINE
SHIPBOARD MAINTENANCE USING VP-EXPERT**

David Wilber Acton - Lieutenant, United States Navy

B.S., United States Naval Academy, 1983

Master of Science in Information Systems - March 1990

Advisor: T. X. Bui - Department of Information Systems

Expert Systems (ES) are characterized by containing the knowledge of a single human expert. Most ES today operate in a "standalone" basis, providing expertise in a specific domain. However, managers making strategic decisions on complex topics require the coordinated assessment and evaluation of knowledge from multiple human experts. Standalone knowledge bases should be loosely or tightly coupled together to form a network of coordinated Distributed Expert Systems (DES). To facilitate this, a "meta-ES" could be designed to access and control these distributed knowledge bases, thus providing users with a single entry point into a vast knowledge network. In the U.S. Navy submarine service, preventive maintenance is important for efficient operation. Since a submarine is constructed of compact, high energy systems, safety is paramount to prevent both personal injury and material damage during maintenance evolutions. The Ship's Duty Officer (SDO) is responsible for the safe and effective execution of all maintenance aboard ship. Thus, he needs to be knowledgeable of how maintenance on one system will affect the operation of other systems. Since the SDO requires many sources of expertise, automating a submarine shipboard maintenance process is an appropriate DES application.

**COUPLING ARTIFICIAL INTELLIGENCE AND A SYSTEM DYNAMICS
SIMULATION TO OPTIMIZE QUALITY ASSURANCE AND TESTING IN
SOFTWARE DEVELOPMENT**

Christopher E. Agan - Lieutenant, United States Navy

B.S., University of Rochester, 1983

Master of Science in Information Systems - March 1990

Advisor: T. K. Abdel-Hamid - Department of Administrative Science

The allocation of effort to quality assurance and testing is vitally important to successful development and maintenance of a software system. There is no quantitative method for finding the right allocation policy. The most common methods include allocating a fixed percentage of effort for all software projects or using allocations that have been used for similar projects in the past. The benefits of choosing the correct manpower allocation to suit a particular project can be substantial. Using the System Dynamics Model of Software Project Management an optimal quality assurance and testing level for a project's development lifecycle can be found. The focus of this thesis is to design an expert system that can be coupled with the model in order to find the optimal allocation of quality assurance and testing effort for a particular project. Two expert system modules were developed, that when coupled with the system dynamics model, will find the optimum quality assurance and testing distributions for a software project. The expert system modules were then used to perform sensitivity analysis experiments on the results.

**PERSONAL COMPUTER LOCAL AREA NETWORK SECURITY IN AN
ACADEMIC ENVIRONMENT**

Richard Ralph Alfini - Lieutenant, United States Navy

A.B., Loyola University of Chicago, 1982

Master of Science in Information Systems - December 1989

Advisor: N. F. Schneidewind - Department of Administrative Science

This thesis explores the unique security requirements of the Local Area Networks (LAN)s within the Administrative Sciences Department Instructional Laboratories at the Naval Postgraduate School, Monterey, California. Current operating procedures, direction from the Department of Defense and Navy sources, views of computer professionals and case studies of microcomputer labs at other educational institutions are examined to identify areas where security improvements can be made. Security topics covered include; physical security, equipment tamper-proofing, software protection and damage caused maliciously or unintentionally by users. The threat imposed on the various LANs by users, viruses and the operating environment are evaluated to determine a suggested security response.

**IS THERE A SHORTAGE OF COMPUTER PROGRAMMERS/SYSTEMS ANALYSTS?
AN EXAMINATION OF THE EMPIRICAL EVIDENCE**

**Steven Schuyler Anderson - Lieutenant Commander, United States Navy
B.A., Auburn University
Master of Science in Information Systems - September 1990
Advisor: W. J. Haga - Department of Administrative Science**

This thesis investigates the alleged shortage of computer programmers and systems analysts. The basic premise of this thesis is to quantify the supply of and the demand for computer specialists to determine whether there is empirical evidence of a shortage. A quantification of the supply of computer specialists is presented. Based on an examination of available literature, there is no quantification information available of the demand for computer specialists.

ECONOMIC DEVELOPMENT OF SMALL-SCALE INFORMATION SYSTEMS

**John Louis Ash, Jr. - Lieutenant Commander, United States Navy
B.S., Virginia Polytechnic Institute and State University
and
Dale Richard Spaulding - Lieutenant, United States Navy
B.S., Auburn University
Master of Science in Information Systems - March 1990
Advisor: T. J. Shimeall - Department of Computer Science**

In virtually any organization, (military or civilian, large or small), there are a number of unsolved small-scale information system problems. They will remain unsolved until we (system analysts and designers) develop a methodology that allows generation of timely and cost-effective automated solutions. The requisite resources exist; they have yet to be combined in the right order for success. It is the primary goal of this research to propose, justify and demonstrate (through a detailed case study) a simple-to-employ methodology for quick and cost-effective development of small-scale information systems (SSIS) without professional analysts, designers or programmers.

**DESIGN AND IMPLEMENTATION OF A PROTOTYPE MICROCOMPUTER DATABASE
MANAGEMENT SYSTEM FOR THE STANDARDIZATION OF DATA ELEMENTS
FOR THE DEPARTMENT OF DEFENSE**

**John S. Bacheller - Captain, United States Marine Corps
B.S., University of Southern California, 1982
Master of Science in Information Systems - September 1990
Advisor: D. R. Dolk - Department of Administrative Science**

The need for data management standardization has been clearly identified by the Office of the Secretary of Defense as a means to realize savings in the \$9 billion spent annually on information technology in DOD and to further the sharing of information. This thesis discusses the importance of data element standardization as a foundation for standardizing Management Information Systems within DOD. Moreover, this thesis identifies the data requirements, functional requirements, logical database design and the application design for a prototype microcomputer dictionary system for standardizing, storing, updating and viewing data elements, the lowest level in the hierarchy of metadata. This prototype dictionary is then implemented in a powerful relational database management system, Paradox 3.0. This system will help developers within DOD to build, store, track and use standard data elements.

TASK MASTER: A PROTOTYPE GRAPHICAL USER INTERFACE TO A SCHEDULE OPTIMIZATION MODEL

Stephen R. Banham - Lieutenant, Civil Engineer Corps, U. S. Navy

B.S., Oregon State University, 1980

Master of Science in Information Systems - March 1990

Advisor: G. H. Bradley - Department of Administrative Science

This thesis investigates the use of current graphical interface techniques to build more effective computer-user interfaces to Operations Research (OR) schedule optimization models. The design is directed at the scheduling decision maker who possesses limited OR experience. The feasibility and validity of building an interface for this kind of user is demonstrated in the development of a prototype graphical user interface called Task Master. Task Master is designed as the Dialog component of a scheduling Decision Support System (DSS). The underlying scheduling model uses set-partitioning and mixed-integer linear programming to generate optimal schedules. Although the model was originally developed to address a specific problem, inter-deployment scheduling of Navy surface ships, Task Master has been designed to be problem-independent, enabling it to address a broad range of scheduling problems with the same general structure. Task Master demonstrates the type of interactive, graphical interface that can be developed specifically for non-specialists. It is easy to learn and to use, and yet fully exploits the power of a sophisticated OR scheduling model. The prototype is implemented on a NeXT computer, chosen for its advanced computational power and state-of-the-art graphical interface development tools.

CONCEPTS HEIRARCHIES FOR EXTENSIBLE DATABASE

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Master of Science in Information Systems - September 1990

Advisor: D. R. Dolk - Department of Administrative Science

This thesis presents a simple and efficient method of implementing a semantic type checking system for use with relational databases. Numeric data typically represent measures of a specific property or characteristic of a real world object. Computers manipulate only the numeric value. It is the responsibility of the user to ensure that the data are handled in a manner consistent with its meaning. If the semantics associated with the numbers are stored in a data dictionary, semantic consistency can be verified by the database system. This increases the integrity of data manipulation and helps ensure meaningful results. This thesis demonstrates a simple scheme of representing the property, or quantity, and unit of measure associated with numeric attributes. This information is then used to verify dimensional consistency of database queries and to automatically convert units across systems of measurement. Finally, a concept is defined for each relation in the database. These concepts can be used to build a concept hierarchy to help ensure queries are consistent with the semantics of the database design.

AN INVESTIGATION OF THE METHODOLOGY FOR SOFTWARE TRANSLATION FROM PASCAL TO C OF AN UNDOCUMENTED MICROCOMPUTER PROGRAM

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Master of Science in Information Systems - March 1990

Advisor: R. Griffin - Department of Computer Science

The purpose of this thesis is to investigate software reusability applications and the practical utilization of those applications in the performance of software maintenance. The translation of a functioning program from one high level language to another was selected as the type of software reusability effort to be explored. Five translation methodologies were investigated and the inverse transformation methodology was chosen to exercise the practical application of software reusability for a specific case study. A design strategy and translation approach was developed based on the inverse transformation methodology. The translation approach was followed in performing the translation of the case study. The results of the application of the methodology to the case study is described and the methodology is evaluated on its usefulness as a tool for software reuse.

A COMPARISON OF PASSWORD TECHNIQUES
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Master of Science in Information Systems - March 1990
Co-Advisors: W. J. Haga & M. Zviran - Department of
Administrative Science

A widely used access control mechanism is the password. Passwords are normally composed of a meaningful detail, such as a name of a person or a sequence of numbers such as a birthdate. Any person attempting to gain unauthorized access to a system might need only to look at a personnel record or associate with the person holding the desired password in order to discover the password. Therefore, there is a compromise between user memorability and security of a system. Exploration into other methods of user authentication and access control is desired to discover a better alternative to the traditional password system. The alternatives are system-generated passwords, pronounceable passwords, passphrases, cognitive passwords and authentication by word association. These methods are discussed and examined. The results from this study show that cognitive passwords and authentication by word association are superior to other methods in access control.

ANALYSIS AND EVALUATION OF COMPUTER SUPPORT AFLOAT SUBMARINE IMA
MAINTENANCE PLANNING

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Master of Science in Information Systems - March 1990
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Late identification of work and inadequate administrative controls are principle causes of untimely preparation of Controlled Work Procedures (CWP) at one heavily loaded, afloat, submarine Intermediate Maintenance Activity (IMA). Untimely CWP preparation, however, is symptomatic of a more widespread problem of inadequate communications and decision support in the IMA maintenance planning process. The Maintenance Resources Management System's (MRMS) Engineered Time Value standards provide significant improvement in resource estimation accuracy over the Maintenance and Material Management (3-M) Intermediate Maintenance Management System (IMMS). However, both IMMS and MRMS (version 0) emphasize transaction processing and structured, upline reporting. Neither system provides tools necessary for optimal decision making to IMA maintenance supervisors.

DESIGN AND IMPLEMENTATION OF AN INTELLIGENT COST ESTIMATION
MODEL FOR DECISION SUPPORT SYSTEM SOFTWARE

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Master of Science in Information Systems - September 1990
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Recently, Decision Support Systems (DSS) have increased in importance and usage. However, these increases have not carried over into developing better models to estimate the real cost of developing the DSS. This thesis explores various estimation methods that seem pertinent to DSS. It advocates the use of a combination of modeling tools particularly tailored to the users' environment. An Intelligent Cost Estimation Model (ICESM) for Decision Support System software is proposed. To promote user-friendliness, ICEM uses a rulebased front-end interface coupled to a spreadsheet program. For comparison purposes the current version of ICEM includes the Intermediate COCOMO model, the Intermediate COCOMO model particularly calibrated for the in-house DSS development environment, and a parametric model which incorporates the function point size metric.

EXTENDING THE SYSTEM DYNAMICS MODEL OF SOFTWARE PROJECT MANAGEMENT TO A MULTIPROJECT ENVIRONMENT

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Master of Science in Information Systems - March 1990

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Increase the demand for software, coupled with concerns regarding cost overruns and schedule delays in software development lead experts to believe that the United States will be unable to produce the software it needs. In order to improve their performance, software professionals must first understand the development process. The System Dynamics model of software project management provided a tool for the understanding of a single project. This tool was expanded to model a multiproject environment in which more than one project is managed. Identification and addition of the variables necessary to reflect manpower decisions resulting in movement between projects and within an organization were effected. This enhancement provided insights into the allocation of resources to projects and into the optimization of the staffing function.

DISTRIBUTION OF DATABASES ON CD-ROM

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and**

**Paul Gordon Scyoc - Lieutenant, Supply Corps, U. S. Navy
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Master of Science in Information Systems - September 1990

Advisor: B. A. Frew - Department of Administrative Science

The vast majority of information distributed throughout the Navy today is done so using various paper products in the form of manuals, printouts, books and other publications. Paper publications are inherently expensive to produce, store and distribute on a large scale. They are also difficult to use when extracting detailed information for ad hoc reports. Compact Disc, Read Only Memory (CD-ROM) technology provides an alternative means to publish and distribute information to large numbers of users. This thesis examines the capabilities, advantages and disadvantages of CD-ROM technology to determine whether its use would be a preferred strategy for fulfilling information distribution requirements within the Navy. The research included the development of a CD-ROM pre-master file which was used to test the response of a CD-ROM application compared to manually extracting the same information from a printed manual.

A PROLOG IMPLEMENTATION OF PATTERN SEARCH TO OPTIMIZE SOFTWARE QUALITY ASSURANCE

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Master of Science in Information Systems - March 1990

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Quality Assurance (QA) is a critical factor in the development of successful software systems. Through the use of various QA tools, project managers can ensure that a desired level of performance and reliability is built into the system. However, these tools are not without cost. Project managers must weight all QA costs and benefits for each development environment before establishing an allocation strategy. The development of a system dynamics model has provided project managers with an automated tool that accurately replicates a project's behavior. This model can be used to determine the optimal quality assurance distribution pattern over a given project's life cycle. The objective of this thesis was to enhance a prototype expert system module that interacts with the system dynamics model for determining QA effort allocation schemes. The new module uses a pattern search algorithm to derive an optimal distribution scheme from a given set of project parameters. This system not only resolves all limitations discovered in the prototype model, but also achieved significant reduction in total project cost.

**A NAVAL AVIATION MAINTENANCE ORGANIZATION ACTIVITY
STRATEGIC INFORMATION SYSTEM (OASIS)**

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Master of Science in Information Systems - March 1990

Advisor: M. J. McCaffrey - Department of Administrative Science

Organizational Maintenance Activities (OMAs) within the Naval Aviation Maintenance organization do not have an adequate information system (IS). This seriously degrades their ability to efficiently and effectively manage their aircraft, equipment, and personnel. Information systems to support both Naval Air Systems Command (NAVAIR) and the operational chain of command include Naval Aviation Depot Information System (NADIS), Naval Air Logistics Data Analysis (NALDA), and Naval Aviation Logistics Command Management Information System (NALCOMIS). The portion of NALCOMIS intended to support OMAs is not scheduled to be fully implemented until 1999. Decisions made at OMAs have an immediate impact on force readiness and mission capability. Moreover, the largest unfulfilled need for information systems in the naval aviation community is at the OMAs. This thesis examines the history of IS in Aviation Maintenance, analyzes why OMAs lack adequate ISSs, and offers a solution within the current technological capabilities of the aviation maintenance community. The potential improvement in operational readiness, avoidance of increased maintenance and personnel costs, improved decision making, and accuracy of information made available to all levels of the Navy chain of command makes implementing an Organization Activity Strategic Information System (OASIS) imperative.

**RELATIONAL DATABASE DESIGN OF A SHIPBOARD AMMUNITION INVENTORY, REQUISITIONING,
AND REPORTING SYSTEM**

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B.S., University of Puget Sound, 1981

Master of Science in Information Systems - June 1990

Advisor: M. N. Kamel - Department of Administrative Science

This thesis defines the analysis and design necessary to automate the current manual procedures for inventory, requisitioning, and reporting of shipboard ammunition. After verifying data and functional requirements of the system, this study specifies the logical database design and application design of a relational shipboard ammunition management database application. In addition, the PARADOX relational database management system software package is used to implement the relations and specify the required reports for a prototype application. The potential for integrating an expert system with this shipboard ammunition relational database is discussed and other areas for future work are suggested.

**THE ANALYSIS AND DESIGN OF MICROCOMPUTER BASED LOCAL AREA NETWORKS
FOR PUBLIC WORKS DEPARTMENTS OF NAVAL FACILITIES COMMANDS**

Brad C. Drummond - Captain, United States Marine Corps

B.S., United States Naval Academy, 1984

Master of Science in Information Systems - March 1990

Advisor: R. K. Mott - Western Division Naval Facilities Engineering Command

The purpose of this thesis is, through the application of both academic theory and practical procedures, to present a manual which outlines a step wise procedure for the analysis and design of a microcomputer based Local Area Network for the Public Works Departments of Naval Facilities Commands. A brief overview of the Public Works structure and operations is conducted. Analysis and design objectives, along with a methodology for achieving these objectives are tendered. Finally, a review of the essential parts of the Requirements Evaluation Report is presented.

**IDENTIFYING SECURITY PROBLEMS AND DEVISING CONTROL SOLUTIONS
IN A LOCAL AREA NETWORK: A CASE STUDY APPROACH**

**Gary John Evans - Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1978
Master of Science in Information Systems - September 1990
Advisor: T. X. Bui - Department of Administrative Science**

This thesis investigates the requirements for establishing security criteria in designing and developing a local area network (LAN) for an aviation squadron. In particular, it concentrates on the security problems and control issues in the design of a LAN. A survey of the security literature on computer security was conducted to develop a model for identifying security problems in a local area network and devise control solutions. A case study was written based on the literature review and previous experience in the aviation community. Although many controls solutions are discussed, adequate planning, common sense and proper user training all play an integral part in developing an atmosphere of security awareness in networks.

**CERTS: A COMPARATIVE EVALUATION METHOD FOR RISK
MANAGEMENT METHODOLOGIES AND TOOLS**

**William M. Garrabrants - Major, United States Marine Corps
B.A., University of Washington, 1975
and
Alfred W. Ellis III-Major, United States Marine Corps
B.S., University of West Florida, 1984
Master of Science in Information Systems - March 1990
Advisor: L. J. Hoffman - Department of EE/CS, George
Washington University**

This thesis develops a comparative evaluation method for computer security risk management methodologies and tools. The subjective biases inherent to current comparison practices are reduced by measuring unique characteristics of computer security risk management methodologies. Standardized criteria are established and described by attributes which in turn are defined by metrics that measure the characteristics. The suitability of a method or tool to a particular organizational situation can then be analyzed objectively. Additionally, our evaluation method facilitates the comparison of methodologies and tools to each other. As a demonstration of its effectiveness, our method is applied to four distinct risk management methodologies and four risk management tools. Alternative models for utilizing the evaluation method are presented as well as possible directions for their application. Without an adequate means of comparing and evaluating risk management decision-making methodologies, the metadecision (the selection of a risk management method or tool) becomes arbitrary and capricious, thereby making an inappropriate selection more likely. Selection of an inappropriate method or tool could lead to excessive costs, misdirected efforts, and the loss of assets. The systematic and standard comparison method developed in this thesis resolves that problem.

**THE EFFECT OF COMPUTERIZATION ON PRODUCTION IN ADMINISTRATIVE
OFFICES: A COMPARATIVE ANALYSIS**

**Michael O. John - Lieutenant, United States Navy
B.B.A., Branch College, 1979
Master of Science in Information Systems - September 1990
Advisor: W. J. Haga - Department of Administrative Science**

Using a one-group pretest/posttest pre-experimental research design and data collected by questionnaire and taken from archival sources, this study found that while an organization's outputs increased from 28% to 32% after computer support of clerical tasks, labor inputs declined 21%. The findings here support the notation that office automation and word processing in particular, enhanced productivity. These findings do not support a growing concern among investors in office automation that it is counterproductive.

**A STUDY OF THE NAVAL MILITARY PERSONNEL COMMAND: INTERNET
CONNECTIVITY ISSUES, REQUIREMENTS, AND RECOMMENDATIONS**

Robert Edward Johnson - Lieutenant, United States Navy

B.S. University of Kansas, 1984

and

Steven William Peterson - Captain, United States Army

B.S., United States Military Academy, 1982

Master of Science in Information Systems - March 1990

M. W. Suh - Department of Administrative Science

This thesis is a study of the Naval Military Personnel Command (NMPC) and its requirements to interconnect office area/local area networks and mainframe resources to form a comprehensive, organization-wide internet. The paper serves three purposes: it examines NMPC's organizational environment and internet requirements, proposes alternative internet configurations and recommendations, and uses information systems management lessons learned in studying NMPC to make internet planning recommendations of use to other Department of Defense organizations. It is written with the assumption that the reader is familiar with local area networks and accepted government and industry standardization guidelines; however, a series of detailed appendices covering these subjects is provided as an aid to the unfamiliar reader.

**PRINCIPLES FOR THE DESIGN OF STANDARD SECURITY PROTOCOLS FOR
MULTILEVEL NETWORK COMMUNICATIONS**

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Master of Science in Information Systems - December 1989

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The rapid proliferation of communications and computer networks has spawned an urgent need for comparable developments in network security. Significant issues such as message authenticity, transmissions confidentiality and data integrity must be addressed. Unfortunately, extremely few network designs effectively deal with such complex security issues, especially those for multilevel network environments. To encourage greater advancement in this important field, standards are needed to effectively address several aspects of network security. Specifically, standard security protocols are needed to influence the direction of industry in providing multilevel secure network designs. In this thesis, we propose three important principles that will enhance standard security protocol designs. These include the Compatibility Principle, the Inclusion Principle and the Support Principle. We describe the concepts of these design principles and demonstrate their benefits for security protocols in multilevel secure network communications.

**DESIGN AND IMPLEMENTATION OF A DENTAL INFORMATION
RETRIEVAL SYSTEM (DIRS)**

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B.S., University of Colorado, 1985**

and

**Brad R. Triebwasser - Captain, United States Marine Corps
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Master of Science in Information Systems - March 1990

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All Naval dental treatment facilities (DTF) worldwide are required to submit monthly reports containing dental records of treatments provided and overall dental readiness to COMNAVMEDCOM, in Washington, D.C. These reporting requirements are standardized to meet not only the requirements of the Navy, but also as input to the DOD mandated Medical Expense and Performance System (MEPRS). At many commands, this data collection storage and reporting effort is currently performed manually, adding unnecessary additional administrative burden. This thesis develops a computerized database system providing increased accuracy and productivity, and capable of meeting the NAVMED reporting requirements. The Dental Information Retrieval System (DIRS) developed will record all treatments provided for each beneficiary category described in NAVMEDCOMINST 6600.1B, and will facilitate internal and external daily, weekly, monthly and annual reporting requirements. An important design consideration is providing the DIRS developed with the requisite capabilities specified by the DTF's, without imposing additional hardware requirements. NAVDENCLINIC Long Beach, Ca., is the sponsoring activity for the DIRS, and will serve as the test site for system implementation. If the system is successful, Director of Dental Services, San Diego, Ca., has indicated interest in the system as a Navy-wide managerial tool.

REVISED GUIDANCE FOR THE ECONOMIC EVALUATION OF DOD DATA PROCESSING SYSTEMS

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Virtually every aspect of national defense involves computer support. Automation extends to logistics; financial management and administration; health care delivery; command, control, and communications; intelligence; tactical operations; and weapon systems. Because automation requires scarce time and resources, you must understand the available alternatives and their costs and benefits. Economic analysis gives you the tools you need to evaluate and compare the alternatives. Appendix E of this study gives you revised routines for doing an economic analysis. This guidance assumes that you are a novice in the field of economic analysis. Thus, the guidance develops material slowly, from a few very basic economic and common sense principles. While you can easily apply these techniques to many investment problems, this study limits the guidance to the economic problem of choice within the ADP arena.

ACMS: A PROTOTYPE EXPERT DATABASE FOR AIR COMBAT MANEUVERING

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In combat situations, a fighter pilot must deal with a large number of input variables and decision alternatives in a very short time. To have the greatest chance of success in an encounter, the pilot must have a viable game plan in mind before he engages with an enemy aircraft. This game plan comes about through many hours of expert training in various scenarios of actual and hypothetical situations. This study describes the design and implementation of a prototype expert database training system for air combat maneuvering. The architecture of the system integrates a rule-based expert system with a database in a loosely coupled fashion. The expert system component of the system uses its rule base, and pilot input to arrive at its decision.

**THE APPLICABILITY OF EXPERT SYSTEMS TECHNOLOGY TO INSURGENT
IDENTIFICATION IN A TACTICAL MILITARY ENVIRONMENT**

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As the threat of large-scale, conventional warfare diminishes, the United States will increasingly find itself, and its military forces, involved in low-intensity, insurgency, revolutionary, and guerrilla warfare as an intervening power. One especially critical aspect of counterinsurgency operations is the rapid and accurate identification of insurgents and cause-sympathetic individuals. This task is normally accomplished by an experienced and knowledgeable expert in insurgent identifications, but appears to be particularly well suited for the application of expert system technology. This thesis is concerned with examining the applicability and feasibility of using expert systems technology for the development of a computerized screening system capable of assisting in the identification of insurgent and cause-sympathetic individuals in a tactical military environment.

**THE CLASSIFICATION AND EVALUATION OF COMPUTER-AIDED SOFTWARE
ENGINEERING TOOLS**

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The use of Computer-Aided Software Engineering (CASE) tools has been viewed as a remedy for the software development crisis by achieving improved productivity and system quality via the automation of all or part of the software engineering process. The proliferation and tremendous variety of tools available have stretched the understanding of experienced practitioners and has had a profound impact on the software engineering process itself. To understand what a tool does and compare it to similar tools is a formidable task given the existing diversity of functionality. This thesis investigates what tools are available, proposes a general classification scheme to assist those investigating tools to decide where a tool falls within the software engineering process and identifies a tool's capabilities and limitations. This thesis also provides guidance for the evaluation of a tool and evaluates three commercially available tools.

END-USER COMPUTING STRATEGY IN THE UNITED STATES MARINE CORPS

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The use of End-User Computing (EUC) in the Marine Corps has increased dramatically in recent years. As Marine Corps-sponsored programs progressed, large General Services Administration (GSA) contracts were established which made it relatively easy for government agencies to acquire microcomputers. A strongly centralized strategy, successful in the management of the Marine Corps' mainframe systems, was adopted for the EUC program. This thesis concludes that the centralized strategy embraced by the Marine Corps is inappropriate to contend with the problems faced at the end-user level. End-users must be made an active part of the EUC process for lasting success. More importantly, current inadequacies in support and education must be addressed immediately to ensure effective use of the assets already procured.

ESTABLISHING A SELECTED RESERVE CORPORATE DATABASE
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Advisor: R. Knight - Department of Administrative Science

The Director of Naval Reserve and Commander, Naval Reserve Force (CNRF) are totally dependant on the Commanding Officer, Naval Reserve Personnel Center (NRPC) and the Inactive Manpower and Personnel Information System (IMAPMIS) automated information system for the control of all functions of Selected Reserve (SELRES) mobilization billet information, personnel billet assignments, personnel pay and tracking individual member retirement credit. Although recently converted from a flat file system to a relational database, IMAPMIS does not meet functional requirements for timely update and correction of critical data. IMAPMIS's poor responsiveness and lack of ad hoc query capability make it obsolete and virtually unusable for SELRES data. The purpose of this thesis is to examine the present functions of IMAPMIS and identify its shorfalls. This is followed by recommended alternative to establish a separate SELRES database, administered by CNRF, that will internally process data and feed updated information to external systems such as IMAPMIS.

COGNITIVE FEEDBACK AS A TOOL FOR KNOWLEDGE ACQUISITION
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Knowledge acquisition is often considered a "bottleneck" in the development of expert systems. This study conducted a review of 14 knowledge acquisition methods with a survey of knowledge types, task characteristics, and representation schemes. All of the knowledge acquisition techniques are considered deficient in their ability to capture a representation of an expert's mental model and procedural knowledge. Cognitive feedback and the lens model, drawn from Egon Brunswik's probabilistic functionalism, are proposed as an alternative knowledge acquisition methodology. Cognitive feedback's theoretical underpinnings are explained as are the various uses to which it has been put. A summary of the many research studies conducted into the effectiveness of cognitive feedback is presented. An automated knowledge acquisition tool using cognitive feedback is proposed and illustrated with state transition diagrams and sample computer screens.

PROTOTYPE DEVELOPMENT AND REDESIGN: A CASE STUDY
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This thesis attempts to document the events, environment, decisions, and personnel involved in the development, implementation and life cycle management of a computer software application. The computer application is developed using a prototyping methodology and a third generation software language for a Department of the Navy Headquarters Command. The data are presented in a case study format and are analyzed in accordance with software life cycle development principles and change management principles. The case methodology was considered the most applicable tool to showcase the complexity of decisions and processes of computer systems management. The case studies demonstrate the importance of adhering to proven software development principles throughout the life cycle mangement of a computer application.

**IMPLEMENTATION CONSIDERATIONS TO CONNECT AN IBM TOKEN RING
LAN TO THE DDN USING TCP/IP PROTOCOL**

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Master of Science in Information Systems - March 1990

Advisor: N. F. Schneidewind - Department of Administrative Science

The Naval Postgraduate School in Monterey, California provides graduate education to commissioned officers and selected Department of Defense (DoD) personnel in a wide variety of subjects important to the military. One of these subjects is computer networks--specifically the DoD Defense Data Network (DDN) which plays a critical role in data transmission. Understanding the DDN and how to use it is immediately applicable and important to the students in their military careers. There is also faculty research in the development and use of the DDN. In addition, the DDN provides excellent electronic mail and a wealth of bulleting board and information services for a variety of users. The Administrative Sciences department is expanding its LAN-to-DDN connectivity so as to offer services common to most LANs as well as direct access to the DDN. The department has an IBS Token Ring network for this educational environment. This paper reviews the issues a network manager must consider to provide LAN-to-DDN connectivity. Particularly the DDN, token ring networks, the campus backbone network, protocols, TCP/IP software and design issues a manager should consider in making this connectivity occur.

MANAGEMENT CONCERNS FOR OPTICAL BASED FILING SYSTEMS

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The use of optical technology has been assessed as the next step in the storage of information. Optical imaging systems for paper management have the potential benefits of improving productivity and permitting access to information on paper quickly. Although optical media is a relatively new technology there are many articles addressing the uses for optical media. With the exception of compact disks, optical disks have not gained rapid acceptance even though the market potential due to the storage capabilities of optical disks is much greater than standard magnetic media. One aspect about optical systems that does not receive much attention is how organizations should introduce optical media filing systems in their organizations. Speed, compatibility with current systems, paper administration, legal issues and strategic planning are just a few of the issues that have to be addressed. This thesis investigated managment concerns which must be addressed when considering document imaging systems.

**DECISION MAKING HEURISTICS AND BIASES IN SOFTWARE PROJECT
MANAGEMENT: AN EXPERIMENTAL INVESTIGATION**

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Software project development has been plagued with an infamous reputation for cost overruns, late deliveries, poor reliability and users' dissatisfaction. Much of this blame has been placed on the managerial side of software development. The Systems Dynamic Model of Software project Management is a quantitative model of software project dynamics that is attempting to gain some valuable insight into the managerial side of developing software systems. The objective of this thesis is to use the Systems Dynamic Model's gaming interface to investigate managerial heuristics and biases in software project management. Specifically, three experiments were executed to determine the effect of "anchoring" on productivity estimation, the effect of poor cost estimation on staffing decisions and the effect of "social loafing" on a software project's staffing decisions, final cost and final duration.

**CONVERSION, INTEGRATION, AND MAINTENANCE ISSUES OF NAVY
STOCK POINTS EXPERT SYSTEMS**

**Aaron Mitchell Rouska - Lieutenant, United States Navy
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Master of Science in Information Systems - March 1990
Advisor: T. Bui - Department of Administrative Science**

The Naval Postgraduate School has developed a number of small expert system prototypes for the Naval Supply Systems Command (NAVSUP) to automate some functions in inventory management. These expert systems were developed to aid the inventory managers at Navy Stock Points during the last several years. Several thesis students have successfully developed three separate stand-alone functioning and employable systems which run on MS-DOS based machines and which use different knowledge representation approaches and different programming languages. Since these prototypes were built, new expert systems shells have become available. Because of advances in technology and the drives toward integration today, integration of these prototypes is important to enhance man-machine interface, increase system performance, and facilitate maintenance tasks. This thesis addresses the generic requirements needed to convert, integrate and maintain the rule bases of three stand-alone expert systems and combine them into one functioning integrated expert system. It then provides such a system in a VP-EXPERT shell and describes the specific details of the conversion effort. Improvements needed are also discussed.

IMPROVING DATA QUALITY IN THE ENLISTED MASTER FILE

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In this paper, the importance of maintaining the quality of information in the Enlisted Master File will be established. The Enlisted Master File is generated by the Navy Enlisted System, one of many applications which process data for the Manpower, Personnel, and Training community. To clarify what technologies, policies, and procedures can contribute to improved data quality, a framework for classifying these initiatives is developed. The data quality control environment of the Navy Enlisted System is then evaluated with respect to that framework. Two deficiencies in the data quality control environment are identified. One is the lack of techniques to measure the quality of data in the Enlisted Master File, and the other is the lack of comprehensive plans for data quality control for the data base which will be a successor to the master file. A technique for assessing data quality is then tested, but its application to the Navy Enlisted System was not successful in this limited study. Technologies which could contribute to enhanced data quality in the environment of the future are discussed, and a plan for actively managing data quality is proposed. In closing, specific recommendations for improving the current data quality control environment in the Total Force Information Systems Management Department are presented.

THE CHARACTERISTICS OF USER-GENERATED PASSWORDS

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Master of Science in Information Systems - March 1990

Advisors: M. Zviran & W. Haga - Department of Administrative Science

Access control based on the verification of a person's identity is commonly used in information system/computer installations. The most widely used mechanism for access control to information systems is passwords. Passwords can be machine-generated using a list of words stored in a memory bank, machine-generated using a sophisticated algorithm to create a pseudo-random combination of characters or they can be user-generated. User-generated passwords typically take on the characteristics of some type of meaningful detail that is simple in structure and easy to remember. Memorability and security pose a difficult trade-off in password generation. On one hand a system security administrator wants passwords that are unpredictable, frequently changed and provide the greatest degree of system security achievable. Users, on the other hand, want passwords that are simple and easy to remember. If passwords are chosen to make them difficult to remember they are likely to be written down. Once written down a compromise to security occurs because users tend to store them in insecure places. This thesis looks at user-generated password characteristics. Of particular interest is how password selection, memorability and predictability are affected by the number of characters in a password, the importance and sensitivity of a users data, a users work location, how a password was chosen, the frequency of changing a password and the frequency of logging on to a system with a password.

CYCLOMATIC COMPLEXITY AS A UTILITY FOR PREDICTING SOFTWARE FAULTS

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Master of Science in Information Systems - March 1990

Advisor: T. J. Shimeall - Department of Computer Science

The cyclomatic complexity metric provides a means of quantifying intra-modular software complexity, and its utility has been suggested in the software development and testing process. In this study, an empirical analysis was undertaken to examine the relationship between the cyclomatic complexity and the incidence of faults in a series of eight relatively large (from 1200 to 2400 LOC) complex programs. Each of these programs was developed from a single program specification and subsequently subjected to rigorous unit level testing. A comparison was also made between the relationship of cyclomatic complexity to faults and the relationship of Lines of Code (LOC) to faults. The results of this study support a relationship between the cyclomatic complexity and the incidence of faults. Further, a relationship between LOC and faults is demonstrated. It could not be shown that there exists a stronger relationship between cyclomatic complexity and faults than LOC and faults.

**HYPERMEDIA AND DIGITAL OPTICAL MEDIA TECHNOLOGIES AS APPLIED TO A
PROTOTYPE GEOGRAPHIC AND THREAT RECOGNITION (GEOTREC) TRAINING
AND REFERENCE TOOL**

**Wayne F. Sweitzer - Lieutenant, United States Navy
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Master of Science in Information Systems - March 1990

Advisor: B. A. Frew - Department of Administrative Science

Threat recognition and geographical training are fundamental parts of the requisite knowledge base for a large number of naval personnel who are assigned to operational or operations-oriented support billets. Yet readiness in these areas is often lacking, in large part due to the paucity of readily available, motivational instruction tools. This thesis explores major issues involved in integrating two emerging technologies, hypermedia and digital optical media (DOM), in the context of developing a prototype of just such an application: the GEOgraphic and Threat REcognition (GEOTREC) training and reference tool. The hypermedia software package used to develop the GEOTREC prototype, Hyperdoc version 1.12, gives evidence of the maturation yet needed in the integration of hypermedia and DOM technologies in application authoring tools. This thesis recommends the development of a system at least somewhat analogous to the GEOTREC prototype. Such a tool, using both hypermedia and DOM, would not only provide an enjoyable, intuitive, yet challenging way to foster multi-sensory learning, but also a quick, powerful, and easy-to-use reference to geographical and threat information needed for a myriad of operational scenarios.

**AUTOMATED FINANCIAL MANAGEMENT INFORMATION SYSTEMS FOR NAVY
FIELD ACTIVITY COMPTROLLERS**

**Shaun K. Taylor - Lieutenant Commander, Supply Corps, United States Navy
B.S., University of Idaho**

Master of Science in Information Systems - March 1990

Advisor: G. D. Eberling - Department of Administrative Science

The focus of this thesis is to review, and determine the development of, currently installed automated financial management information systems at Navy field activity comptroller departments that operate under the Navy's Resources Management System. Based upon the findings, develop a guide for use by comptroller department of the development of an automated financial management information system. The resulting guide will be included in the Practical Comptrollership Course and Financial Management in the Armed Forces Textbook, offered by the Naval Postgraduate School in Monterey, California.

THREE CASE STUDIES OF MANAGEMENT INFORMATION SYSTEMS

**Marc The'berge - Lieutenant, United States Navy
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Master of Science in Information Systems - September 1990

Advisor: W. J. Haga - Department of Administrative Science

The Naval Postgraduate School must, by default, make use of teaching cases in information technology case studies oriented or based upon corporations. It has been difficult for the school to obtain such studies oriented to the military, much less the United States Navy. This thesis provides the Naval Postgraduate School with three teaching cases concerning automated information systems serving the administrative and operational needs of unit-level command organizations.

AN EXPERT DATABASE SYSTEM FOR SHIPBOARD MAINTENANCE

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B.S., Texas A&M University, 1979

Master of Science in Information Systems - September 1990

Advisor: M. Kamel - Department of Administrative Science

Current corrective maintenance practices in U.S. Navy ships follow troubleshooting guides found in the paper copies of technical manuals. These manuals are often difficult to find, maintain, and store, and guides are not easily followed. An expert system for troubleshooting could improve current practices by providing a centralized program that is easily maintained and followed. By coupling to a database of procedures, the precise steps to correct the problem could also be called. An expert database system allows an expanded knowledge base that is easily modified while maintaining the integrity of the expert system program. A prototype system for troubleshooting the NAXI 100-2 Low Pressure Air Compressor was developed to illustrate the advantages of expert database technology in this application. VP-EXPERT and DBASE IV were used, and the prototype as demonstrated to SIMA, San Diego, was received favorably. Conclusions drawn supported the feasibility of such systems to assist in the performance of shipboard maintenance.

TOUCH SCREEN USE ON FLIGHT SIMULATOR INSTRUCTOR/OPERATOR STATIONS

Alan Andrew Vasquez - Lieutenant, United States Navy

B.S., United States Naval Academy, 1983

Master of Science in Information Systems - September 1990

Advisor: J. H. Lind - Department of Operations Research

The goal of this study was to aid designers in selecting the best data input device for the design of Instructor/Operator Stations (IOSs). A literature review of touch screen, mouse, and trackball technologies is provided. IOS users were surveyed to evaluate the use of touch screens with several military flight simulators. IOS users' experience level, frequency of touch screen interaction, and familiarity with touch screen, mouse, and trackball devices are provided, along with data on the tasks performed, required accuracy, parallax, arm fatigue, and feelings toward touch screen use. It is concluded that, although touch screens are being used by persons with too much experience and for tasks reported in the literature to be inappropriate, results are generally satisfactory. However, it is recommended that input devices should be matched with the tasks performed.

ALIGNING STRATEGIC AND INFORMATION SYSTEMS PLANNING:

A REVIEW OF NAVY EFFORTS

Glenn W. Zeiders, III - Lieutenant, United States Navy Reserve

B.A., Dickinson College, 1983

Master of Science in Information Systems - March 1990

Advisor: R. L. Knight - Department of Administrative Science

The necessity for well-defined, integrated information systems (IS), driven by today's dwindling human, financial, and management resources, makes it essential to plan effectively. This can only be achieved by linking IS planning to the overall strategic plan of the organization. Department of the Navy (DON) IS planning has historically missed the mark in this respect. Information Engineering (IE), automated through Computer Aided Software Engineering (CASE) technology, offers significant benefits for improving DON IS planning. Two CASE workbenches, Information Engineering Systems Corporation's USER: Expert Systems and Texas Instrument's Information Engineering Facility, have proven highly effective in automating IE in DON applications.

**MASTER OF SCIENCE
IN
MANAGEMENT**

THE TECHNOLOGY TRANSFER APPLICATION IN THE REPUBLIC OF INDONESIA

Umar Abubakar - Commander, Indonesian Navy

M.S., Bandung Institute of Technology, 1982

Master of Science in Systems Management - June 1990

Advisor: R. A. McGonigal - Department of Administrative Science

The main emphasis of this thesis is the examination of technology from a theoretical perspective and comparison of this perspective with its application in the Republic of Indonesia. The elements of a transfer mechanism concept such as organization, project, documentation, distribution, linker, capacity, willingness and rewards are being used for the examination. The role of The Body of the Assessment and Application of Technology (BPPT) as the linker between the source of technology from foreign countries and technology users in Indonesia is observed in particular. It is concluded that the technology transfer process is being successfully conducted from theoretical perspectives, and a recommendation is proposed to the BPPT and its associated linker networks in order to maintain its existing performance.

AN ECONOMIC ANALYSIS OF COUNTERFEIT THREADED FASTENERS IN THE CONSTRUCTION INDUSTRY

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B.S., California State University at Long Beach, 1983

Master of Science in Management - June 1990

Advisor: P. M. Carrick - Department of Administrative Science

This thesis deals with the economic issues associated with the presence of substandard threaded fasteners in the construction industry. It begins with an overview of the engineering concept and terminology which will be used throughout the remainder of the report. A short discussion is presented outlining the various mechanical forces which act upon these fasteners in order to develop an appreciation for the seriousness of the problem. Past and present problems within the fastener industry and market are also covered. The problem is then thoroughly analyzed through the use of mathematical models. The concepts of zero-sum and non-zero sum two player game theory are used to provide possible solutions to the problem.

The optimum solution cannot be reached under the current market structure. The most logical solution will require the intervention of industry associations such as the Industrial Fastener Institute. This issue is addressed in the recommendations section of the last chapter.

CONTRACTING FOR EMBEDDED COMPUTER SOFTWARE WITHIN THE DEPARTMENT OF THE NAVY

Henry Attanasio - Major, United States Marine Corps

B.A., Seton Hall University, 1974

Master of Science in Management - June 1990

Advisor: M. J. McCaffery - Department of Administrative Science

Over the past 15 years, the reliance on computer software, especially within critical weapons systems, has grown in orders of magnitude. Government reports during the same period, however, consistently cite the poor success rate experienced by the Department of Defense in contracting for the development of specialized software as an area of great concern. This thesis investigates the guidance provided by the Department of the Navy, and the contractual methods available, to program managers and contracting officers regarding the procurement of custom designed software. The research conducted concludes that the blame for software procurement problems should fall upon the personnel within the acquisition system. The problem is a problem of "attitude" concerning software development. Although the system is admittedly cumbersome, the underlying causes resulting in cost overruns, schedule delays, and poor performance are not with the mechanics of the procurement system. Program managers and contracting officers currently have the tools available within the acquisition system to improve their ability to contract for the development of custom designed software.

AN EVALUATION OF FACTORS THAT INFLUENCE SERVICE CONTRACT QUALITY

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B.S., United States Naval Academy, 1978

Master of Science in Management - December 1989

Advisor: R. W. Smith - Department of Administrative Science

Until recently quality improvement has been mainly applied to manufacturing. However, experience and the explosive growth of the services industry has shown that opportunities for simultaneous quality improvement must be undertaken. Today, both the Government and contractors are facing growing competitive and regulatory pressures to deliver higher quality services. In an attempt to comply with these pressures more emphasis has been placed on the inspection process and subsequently on the contract administration sections as they are tasked to develop and apply efficient procedures for quality assurance. The research indicated that there are four factors that influence service quality. These factors are: the Quality of Assurance, the Contractor, the Statement of Work and the Performance Requirements Summary. The research concluded that the Government and contractors face the same challenges and must work together to develop a coherent policy on quality, grounded in a common language, common management principles, common standards and common goals.

CHARACTERIZATION OF THE OCEAN GOING BARGE INDUSTRY ON THE WEST COAST OF THE UNITED STATES

Trudy J. Barnum - Lieutenant, United States Navy

B.S., The College of the Ozarks, 1978

Master of Science in Management - June 1990

Advisor: D. C. Boger - Department of Administrative Science

This thesis provides a discussion of the ocean-going barge industry, with a view toward contributing information that may be useful to strategic planners in their efforts to plan for contingencies involving sealife. There have been numerous discussions over the last few years concerning the insufficient sealift available in the military and the merchant marine in the event extensive mobilization is required. In any situation where barges can be used to supplement this sealift short fall, their use will play an increasingly important role. Chapters II and III provide information concerning the types and capabilities of ocean-classed barges and tugs that would be of value to logistic planners, and a brief history of the ocean going barge industry. In order to obtain up-to-date information about the industry, a survey was sent to the West Coast barge owners and operators. The results of this survey are included in Chapter IV, and provide a general description of industry operations on the United States West Coast. Chapter IV also includes a discussion of specific company operations, and inventory information. Company addresses are also provided.

A COST BENEFIT - ANALYSIS OF ESTABLISHING A WAREHOUSE FACILITY FOR THE SERVICES DIVISION OF THE DIRECTORATE OF PERSONNEL & COMMUNITY ACTIVITIES AT FORT ORD, CA

William W. Bartlett - Major, United States Marine Corps

M.S., University of Arkansas, 1987

and

Thomas J. Strel - Lieutenant, United States Navy

B.A., University of Illinois, 1980

Master of Science in Financial Management - June 1990

Advisor: W. R. Gates - Department of Administrative Science

The Assistant Director for Community Family Activities (DCFA) at Fort Ord Army Base requested a cost - benefit analysis to determine if the Services Division of CFA should establish a warehouse operation. This study determined the feasibility of standardizing certain non-perishable products procured with Non Appropriated Fund (NAF) resources, buying them in bulk and issuing them through a new warehouse facility. The analysis of available data indicates that it is not economically justifiable to establish a new warehouse facility in order to make large quantity purchases with subsequent distribution to customer activities. In view of the conclusion, this study provides several cost saving measures which, if adopted by the organization, will result in substantial savings in outlays.

**A STUDY OF REASONS FOR NOT REENLISTING: FIRST-TERM MARINES
IN CRITICAL OCCUPATIONS**

**Timothy Joel Beaty - Captain, United States Marine Corps
B.A., Miami University, 1980**

Master of Science in Management - December 1989

Advisor: M. J. Eitelberg - Department of Administrative Science

This thesis determines the primary reasons why first-term enlistees assigned to critical occupations decide against reenlisting in the Marine Corps. The reasons given for not reenlisting are determined by analyzing responses to the Marine Corps Enlisted Separation Questionnaire over the period of fiscal 1985 through 1989 (third quarter). Questionnaire responses are analyzed using cross-tabulations and frequency distributions according to demographic characteristics (marital status, gender, race, and pay grade) and occupational skill requirements. The results suggest that, for most Marines, lack of promotion opportunity is the main reason for not reenlisting. Other reasons vary by demographic and occupational skill groups. Family separation influences the decisions of women and E-5s, while Marines in more technical specialties are more concerned with compensation. Reenlistment incentives are evaluated using the results of this study. Recommendations are offered to improve current incentives and the criteria for reenlistment.

QUALITATIVE FASTENER STANDARDS: PROCUREMENT ISSUES

David John Beck - Lieutenant Commander, United States Navy

B.S., Metropolitan State College, 1978

Master of Science in Management - December 1989

Advisor: P. M. Carrick - Department of Administrative Science

Counterfeit and substandard fasteners have severely impacted the Department of Defense and the nation. This thesis examines the issues involved. The primary issues examined are: the background of the fastener problem, the development and use of standards and specifications, the specific standards used for fastener procurement and how they were applied. The F/A-18 fastener selection process is reviewed. Occurrences at the Defense Industrial Supply Center relating to fasteners are presented. Potential preventive actions are discussed.

**AN EVALUATION OF CONTRACT TERMINATION
MODELS FOR SECONDARY ITEMS FOR LONG SUPPLY**

Steven Wayne Berger - Captain, United States Marine Corps

B.S., University of Washington, 1985

Master of Science in Management - June 1990

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

This study discusses the use of decision models by the U.S. Navy in determining whether or not to terminate contracts for secondary items which have been identified as being long supply. Long supply for this thesis is defined as those items which are in excess of forecasted requirements and have one or more outstanding contracts either initiated or awarded. The decision variables and parameters of the Chapman Termination Model and the Naval Supply Systems Command's termination model are evaluated in an attempt to determine the feasibility of using each in a working environment at the Navy Aviation Supply Office. The Chapman Termination Model is determined to be an unsuitable model due to the assumptions it makes regarding the availability of certain data, the timeliness of actions, and the relationship between the item manager and the buyer. Recommendations are given for the combining and implementation of the Naval Supply Systems Command's model with the Online Requirements Determination Model currently used by the Navy Aviation Supply Office to form one decision model which could be used by item managers at both Navy inventory control points.

**A CASE ANALYSIS OF NAVY TRANSPORTATION POLICY CHANGES AND THEIR
EFFECT ON INVENTORY LEVELS AT OVERSEAS LOCATIONS**

William M. Blasczyk - Lieutenant Commander, United States Navy

B.A., Saint Cloud State University, 1977

Master of Science in Management - December 1989

Advisor: A. W. McMasters - Department of Administrative Science

This thesis provides an analysis of policy changes directed by the Secretary of the Navy and Commander, Navy Supply Systems Command which have altered the method of transporting spare parts to overseas locations. In particular, an analysis is provided of the affect of resupplying spare parts by surface transportation that had previously been transported by air. The increase in time between air and surface transport required to move these materials is expected to result in the need for increased inventory levels to maintain the authorized protection. This thesis identifies the changes in protection levels needed to maintain an established level of support and attempts to identify the costs incurred in doing so. Analysis focuses on secondary item inventories for Intermediate Maintenance Activity (IMA) support which are maintained by the Naval Air Station (NAS) Rota Spain Supply Department.

**THE INTERNATIONAL USED SHOP MARKET AS A
TEMPORARY SOLUTION TO U.S. SEALIFT REQUIREMENTS**

Gary Boardman - Lieutenant, United States Navy

B.S., U.S. Merchant Marine Academy, 1985

Master of Science in Management - June 1990

Advisor: D. C. Boger - Department of Administrative Science

The objective of this thesis is to examine a possible contingency measure of purchasing available ships on the international market to augment existing capabilities prior to or during a crisis situation. This study explores the already existing procurement process that the Military Sealift Command and the Maritime Administration utilize to acquire ships for the Ready Reserve Force. An in-depth set of data was gathered of past ship sales on the worldwide market from 1977 through 1989. The data intended to explore cyclical patterns, to possibly find explanations as to why prices fluctuate, and to present a legitimate alternative in augmenting sealift by accelerated purchase of used ships.

**JOB SATISFACTION WITHIN THE MILITARY ENTRANCE PROCESSING
STATION AND ITS RELATIONSHIP TO QUALITY OF PERFORMANCE**

Sharon R. Boggs - Lieutenant, United States Navy

B.S., Ohio State University, 1984

Master of Science in Management - June 1990

Advisor: R. D. Evered - Department of Administrative Science

Job satisfaction has been linked to many variables, such as turnover, absenteeism, and productivity. Job satisfaction has rarely, however, been related to the quality of work that is produced on the job. At the various Military Entrance Processing Stations (MEPS) throughout the country, it is the quality of work rather than the quantity of work that is the critical issue. This study first examines the organizational structure and the duties and responsibilities of a MEPS, and then examines the correlation between job satisfaction and quality of performance. Correlations were found only in the Category III (small) MEPS and in Central Sector. Additionally, when the subjectivity of the Sector Commander's Assessment was eliminated from the MEPS Awards Program criteria, a significant correlation was indicated between job satisfaction and quality in the pooled MEPS data.

**AN EVALUATION OF THE PROPOSED MSRT REPLENISHMENT MODEL FOR
WHOLESALE CONSUMABLE ITEMS**

**Richard E. Boike - Lieutenant Commander, Supply Corps,
United States Navy
B.A., University of Minnesota, 1978**

and

**Timothy H. Stringer - Lieutenant Commander, Supply Corps,
United States Navy
B.S.B.A., University of Florida, 1975**

Master of Science in Management - December 1989

Advisor: A. W. McMasters - Department of Administrative Science

This thesis compares the current wholesale level consumable replenishment inventory model, now in use at Navy Inventory Control Points (ICPs), with a proposed Mean Supply Response Time (MSRT) Model. The purpose of the MSRT model is to introduce a readiness measure into wholesale inventory management. The objective of the MSRT model is to determine inventory depths which minimize the mean supply response time subject to not exceeding the inventory dollar investment provided by the UICP model for the same items. The MSRT model uses a marginal analysis optimization procedure. A comparative analysis of the models' results indicates that the MSRT model provides consistently better supply system performance, in terms of supply material availability (SMA) and mean supply response time (in days), than the UICP model for items with a medium to low average quarterly demand. For medium to high quarterly demand items, there is no significant difference in the models' performances.

**APPLICATION OF THE GRAHAM DECISION MODEL FOR SPARE PARTS TO THE
SACRAMENTO ARMY DEPOT**

**Michael E. Bonheim - Captain, United States Army
B.A., Sam Houston State University, 1981**

Master of Science in Management - December 1989

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

The purpose of this thesis is to assess the applicability of the Graham Decision Model for Spare Parts, a process flow chart developed by Lieutenant Ruth Graham, United States Navy, to the wholesale replenishment of communication and electronic repair parts by the Purchasing Division, Directorate of Contracting, Sacramento Army Depot, United States Army Depot Systems Command. The model was developed to be used as a decision tool by Department of Defense item managers and acquisition managers in identifying repair part candidates for Life Cycle Costing. This thesis tests the applicability of the decision model using selected communication and electronic repair parts. The researcher found that Life Cycle Cost factors are not considered during the wholesale replenishment of repair parts at the depot or inventory control point level. The researcher found that performance data are neither available to, nor determinable by, the user of the model in order to fully apply the model and make Life Cycle Costing decisions. The researcher proposes that performance data be collected by the inventory control points through the Commodity Command Standard System for use in Life Cycle Costing decisions. Additionally, the researcher proposes modifications to sequencing of the criteria used in the Graham Decision Model for Spare Parts and recommends two additional criteria for use in the decision process at the Sacramento Army Depot.

U.S./JAPAN BURDENSARING: CONSTRAINTS TO INCREASED JAPANESE CONTRIBUTION

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B.S., Drexel University, 1985

Master of Science in Management - June 1990

Advisors: L. R. Jones & K. Terasawa - Department of Administrative Science

This thesis explores issues relevant to U.S./Japan burdensaring. As U.S. defense expenditures are reduced in the 1990's, U.S. allies will be called upon to contribute a greater share to meet common security responsibilities. Japan's government faces a multitude of constraints to increasing defense expenditures placed upon them by the U.S., the Japanese public and Japan's Asian neighbors. Some of these constraints are affected significantly by Japanese perceptions of U.S. commitment and the Soviet threat. If perceptions of the Soviet threat diminish while perception of the U.S. commitment remain strong, Japan may be less inclined to increase their expenditures to the levels called for by the U.S. This thesis explores constraints to increased Japanese defense spending, Japanese perceptions of U.S. commitment, Soviet threat perceptions in Japan, and also indicates areas for increased Japanese contributions to allied defense capabilities.

IMPLEMENTING STRATEGY IN A BUDGET: A MODEL OF THE COAST GUARD RESERVE

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B.S., State University of New York, 1981

Master of Science in Management - June 1990

Advisor: R. Evered - Department of Administrative Science

This thesis discusses the management strategy of the Coast Guard Reserve; it examines the formulation and implementation of strategy. A model to develop and implement strategy is proposed, which defines the role of the budget in this strategic management process. The recent strategy of the Coast Guard Reserve is analyzed using this model. The analysis seems to indicate that the Coast Guard Reserve had no explicit strategy in the 1980's; however, the Reserve did execute a strategy as inferred from its actions. This implied strategy enjoyed varying degrees of success depending on the criterion of evaluation. Where the criterion shows limited success, I recommend solutions to the various problems. A principle solution involves the Coast Guard Reserve expanding and formalizing the strategic process, including the use of the budget as a means to that end.

DOD PROFIT POLICY-ITS IMPACT ON FACILITIES CAPITAL INVESTMENTS

David John Buck - United States Marine Corps

B.S., Michigan Technological University, 1975

M.B.A., Golden Gate University, 1985

Master of Science in Management - December 1989

Advisor: R. W. Smith - Department of Administrative Science

Since the 1970's profit policy has been used as a vehicle to motivate capital investment in productive facilities and equipment. The current policy has increased the factors available for use when determining a profit/fee objective in order to increase this incentive. Defense contractors and Government procurement personnel are interviewed for their perceptions of their effectiveness of the current policy to incentivize capital expenditures in facilities and equipment. The results of the survey showed that: (1) profit policy has been ineffective in incentivizing defense contractors to invest in more productive facilities and equipment; (2) it is not an important factor when deciding on the contractor's capital budget; and (3) profit policy is not being implemented as originally intended. Recommendations include: (1) encouraging greater use of more direct incentives for capital investment; (2) the need for greater accountability of Government procurement personnel on implementation of the policy; and (3) DoD should review and restate the objectives of the policy so the Services have a clear understanding of what is expected and required.

**BASIC INVENTORY MANAGEMENT TECHNIQUES FOR THE REPUBLIC
OF CHINA NAVY**

**Cheng-Wen Cheng - Lieutenant, Republic of China Navy
B.S., National Defense Management School, Republic of China
Master of Science in Management - December 1989
Advisor: D. Trietsch - Department of Administrative Science**

Lacking further development of mathematical inventory models and well utilized automated records, the Republic of China (ROC) Naval Supply system cannot operate efficiently and effectively. The constraints of budget, foreign exchange and unpredictable procurement lead times have resulted in an inventory level higher than optimal. However, the inventory management process and overall supply support performance could be improved using theoretical and practical approaches. The three objectives of this thesis are: to analyze the ROC Navy's inventory models; suggest possible improvements; and recommend appropriate changes. The desired benefits would be to improve the existing inventory management system, and relieve inventory control problems in the ROC Navy.

**A STUDY OF U.S. ARMS SALES AND THE TRANSFER OF DEFENSE TECHNOLOGY TO THE
NAVY OF THE REPUBLIC OF CHINA (TAIWAN)**

**Kuan Chu-Cheng - Lieutenant Commander, Republic of China Navy
B.S., Chinese Naval Academy, 1979
Master of Science in Management - June 1990
Advisor: R. A. McGonigal - Department of Administrative Science**

U.S. Foreign Military Sales to ROC in Taiwan have always been a controversial matter, and the United States has often yielded to the pressure of Communist China. The Taiwan Relations Act was designed by Congress to provide adequate safeguards for the well being of Taiwan. But the law is too flexible for implementation to be effective, and effectiveness seems to rest largely on the faith of the executive office. The strategic location of Taiwan has great significance for U.S. strategic political and economic interests in East Asia and the Western Pacific. Gen. Douglas MacArthur described the island as an "Unsinkable Aircraft Carrier." As the security of Taiwan is intimately lined to the overall security of the Pacific Area. U.S. defense technology transfer is of prime importance to help Taiwan upgrade their defense capability for protecting the sky and sea lanes over the Taiwan Strait.

**COMPUTING REQUISITIONING OBJECTIVES FOR THE KOREAN AIR FORCE
INVENTORY MANAGEMENT SYSTEM**

**Sung Kyu Choi - Captain, Republic of Korea Air Force
B.A., Korea Air Force Academy, 1982
Master of Science in Management - December 1989
Advisor: D. Trietsch - Department of Administrative Science**

This thesis investigates the structural inconsistency of the Korean Air Force's inventory management system for aircraft spare parts. Recommendation for solving key problems in the inventory system including the Requisitioning Objectives computational methods are provided. Additionally, this study provides Korean Air Force personnel with a greater understanding of their inventory models and Requisitioning Objectives (RO) concepts. Several inventory system models in the literature, including those used in the U.S. Air Force and the U.S. Navy, are explained.

**A COMPARATIVE ANALYSIS OF INTERMEDIATE SERVICE COLLEGE (ISC)
PHASE I JOINT PROFESSIONAL MILITARY EDUCATION (JPME)**

Edward S. Clark - Lieutenant Commander, United States Navy

B.A., Bowdoin College, 1976

Master of Science in Management - March 1990

Advisor: J. Tritten - Department of National Security Affairs

This thesis compares the four Intermediate Service Colleges (ISC) and the Defense Intelligence College (DIC) Phase I Joint Professional Military Education (JPME) curricula and student and faculty mixes. It asks the question, "Is it feasible to offer a Phase I JPME curriculum at the Naval Postgraduate School?" The results clearly show that a Phase I JPME program is feasible if established within the National Security Affairs/Intelligence (NSA/I) and the Joint Command, Control and Communications (C3) curricula. In these curricula, the student and faculty mixes can be easily attained and the curriculum can be established with minimum disruption to the graduate education mission of the Naval Postgraduate School. Additionally, with six core courses established as Phase I JPME, students from other curricula may be tracked into Phase I by detailers on a case-by-case basis. Ultimately, this would increase the number of Navy Phase I JPME graduates by 69 percent. These graduates would then be available for Phase II and further on Joint Duty Assignments (JDAs).

**LIFE CYCLE COST: AN EXAMINATION OF ITS APPLICATION IN THE UNITED
STATES AND POTENTIAL FOR USE IN THE AUSTRALIAN DEFENSE FORCES**

John D. Clarke - Lieutenant, Royal Australian Navy

B.A., University of New South Wales, 1983

Master of Science in Management - June 1990

Advisors: M. G. Sovereign - Department of Operations Research

E. N. Hart - Department of Administrative Science

This research has two objectives: firstly, to examine the application of life cycle costing in the United States; and secondly, to discuss its potential for use in the decision making of the Australian Defense Forces. It has been found that despite almost 30 years of application in the United States, life cycle cost for the most part, is given little real attention in decision making. Reasons for this include: an institutional emphasis that accords greater attention to acquisition cost than life cycle cost; and the dominance of a budgeteers view of life cycle cost as a technique for affordability analysis, an approach which the current state of the data does not readily support. Life cycle cost's greatest potential is as a criteria to evaluate and tradeoff design and logistics issues, but it receives comparatively little emphasis in the U.S. in these areas. For Australia to avoid the problems experienced in the U.S., there needs to be acceptance at all levels of the concept of life cycle cost, and what it is trying to achieve. Since the cornerstone of the techniques of life cycle cost analysis is the data, an accounting system capable of capturing direct and indirect costs is needed. This study contains seven broad points for Australia to consider in implementing the techniques and concept of life cycle cost.

**COMPUTERIZED POINT OF SALES SYSTEM, MORALE, WELFARE,
AND RECREATION DEPARTMENT LONG BEACH, CALIFORNIA**

James Joseph Coltellaro - Lieutenant, United States Navy

B.S.C.E., Villanova University, 1980

Master of Science in Management - June 1990

Advisor: L. J. Zambo - Department of Administrative Science

This is a study to determine the need for a computerized Point-Of-Sales system for the Navy Golf Course Pro Shop located in Long Beach, California; All facets of the Pro Shop's operations were examined including inventory control and cash management. An analysis into which particular system to procure was based on the ability to solve current problems, acquisition costs and the ease of installation and training.

**ANALYSIS OF SETUP TIME REDUCTIONS AT NADEP,
NORTH ISLAND, UTILIZING THE SMED APPROACH
(SINGLE-MINUTE-EXCHANGE-OF-DIE)
Michael L. Combs - Captain, United States Marine Academy
B.S., United States Naval Academy
Master of Science in Management - June 1990
Advisor: D. Trietsch - Department of Administrative Science**

This thesis is an analysis of setup time considerations currently employed by the Power Plant Facility at the Naval Aviation Depot, North Island. The system analyzed within a productive context, citing present procedures that adversely affect lead time. To reduce lead time variability, reduction of setup times is targeted. This thesis examines the potential benefits available to the Power Plant Facility by applying Single-Minute-Exchange-of-Die (SMED) to reduce setup times. SMED's conceptual stages are first examined and then related to the Power Plant Facility to illustrate the applicability of SMED to a repair/rebuild environment. Recommendations are made to reduce setup times in two work centers.

**MEEBS: A MODEL FOR MULTI-ECHELON EVALUATION BY SIMULATION
Maxwell W. Cornwall - Squadron Leader, Royal Australian Air Force
B.E., Western Australian Institute of Technology, 1978
Master of Science in Management - June 1990
Advisor: A. W. McMasters - Department of Administrative Science
M. P. Bailey - Department of Operations Research**

This thesis describes a simple-to-use, multi-echelon, single-item, simulation model written in SLAM II. The model simulates the operation of Recoverable Items (RIs) at one or more bases and the flow supporting RIs through a multi-echelon maintenance system. The model can be configured by the user to simulate a system consisting of one to three maintenance echelons with one to six bases. Lateral resupply is also an option. The model uses an (s-1,s) inventory policy. The model calculates several performance measures including operational availability, mean supply response time, and time-weighted backorders. The operating time for each RI is an exponential random variable. The mean failure rate is input by the user and may be different for each base. Each maintenance echelon has a single queue where failed RIs wait for an unavailable maintenance station/server. Each echelon can have any number of servers as determined by the user. The default distribution for repair time is the lognormal, but other distributions can be used. The shipping times between all bases and echelons are also determined by the user.

**AN ANALYSIS OF A PROPOSED NAVY COLLEGE FUND
Roy W. Crowe - Lieutenant, United States Navy
B.A., Lycoming College, 1980
Master of Science in Management - December 1989
Co-Advisors: S. L. Mehay & M. J. Eitelberg - Department of
Administrative Science**

In this thesis the author examines the impact of enhanced educational benefits in the form of a Navy College Fund (NCF) on Navy recruiting. This thesis examines the effects of the Army College Fund on the accession of high-quality recruits the Navy could expect if a similar program were implemented for the Navy. An attempt is made to compare the cost-effectiveness of high-quality enlistees with that of lower-quality enlistees. In addition, the costs of the proposed NCF is compared with the costs of alternative recruiting policies. The results suggest that a new NCF could offer a cost-effective method to increase the quantity of high-quality enlistees. Several recommendations are offered regarding the implementation of such a program.

**AN IMPLEMENTATION GUIDE FOR SETTLING CONTRACT DISPUTES WITHIN
DOD USING ALTERNATIVE DISPUTES RESOLUTION METHODS**

Karen K. Day - Captain, United States Army

B.S., University of Florida, 1973

Master of Science in Management - December 1989

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

This thesis discusses how to select alternative methods for resolving contract disputes other than the traditional disputes methods which are available under the Contract Disputes Act of 1978. The thesis first presents the different alternative disputes resolution techniques, (ADR). The various processes are broken into those methods which may be used within DoD and those methods which are currently not usable for a variety of reasons. From there, the thesis introduces a list of case criteria which are relevant to choosing an appropriate ADR method. The criteria were compiled from a number of references in the ADR field. The criteria are then matched to appropriate ADR choices using a matrix. Only the usable ADR choices are analyzed for selection. Finally, the reader is given a simple step by step guide using the matrix. The guide assists the reader in choosing whether to use an ADR method, and which method to choose if ADR is used. The final choice of method is based on analysis of the case criteria and matching the criteria with the right method or methods in the matrix tables provided.

**INITIAL RESEARCH ON AN INVENTORY CONTROL PROCESS FOR LOW
ATTRITION REPAIRABLE ITEMS**

Mark D. Dexter - Lieutenant, Supply Corps, United States Navy

B.S., Miami University, 1980

Master of Science in Management - December 1989

Advisor: T. P. Moore - Department of Administrative Science

This thesis presents the initial research findings for a proposed wholesale level inventory control process for low attrition Depot Level Repairables (DLRs) and is the start of a continuing research effort directed by Thomas P. Moore of the Naval Postgraduate School. The main objectives of this study were to determine if the data required for the proposed model were available in the existing data bases at the Navy Ships Parts Control Center (SPCC) or available from other sources, collect the data for a small number of DLRs, and make recommendations for future study. The major conclusion was that implementation of the proposed model would require major changes in SPCC's current repair induction policies and procedures.

A DICTIONARY OF ACQUISITION AND CONTRACTING TERMS

Daniel Lee Downs - Lieutenant, United States Navy

B.S., Husson College, 1980

Master of Science in Management - December 1989

Advisor: D. V. Lamm - Department of Administrative Science

This thesis is a continuation of research initiated by LCDR Daniel Ryan, SC, USN to establish a basis for defining words and terms used in the field of contracting. It offers a sample of published definitions presently used in Government contracting. A synthesis of different published definitions was produced and the results sent to recognized professionals in the contracting discipline for their opinion. Their feedback was used to arrive at an acceptable definition of the words and terms offered. Concurrent research in this area is being conducted by students at the Naval Postgraduate School, Monterey, California, and the Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. Follow-on work needs to be done to define other words and terms in the contracting field using the procedure established by LCDR Ryan. The 25 contracting terms for which consensual definitions were established are presented.

**FUTURE NAVY NURSE CORPS GRADE DISTRIBUTIONS: AN ANALYSIS OF THE
IMPACT OF RELIEF FROM CONSTRAINTS IMPOSED BY THE DEFENSE
OFFICER MANAGEMENT ACT OF 1981**

**Karen A. Doyle - Lieutenant Commander, United States Navy
B.S.N., University of Southern Mississippi, 1976
Master of Science in Management - December 1989
Advisor: P. R. Milch - Department of Operations Research**

This thesis introduces FORCE, an interactive computer model to assist community managers in analyzing the impact of proposed changes in recruiting, retention and promotion policies. Here, the model is used to evaluate the effect of proposed legislation which would exclude the U.S. Navy Nurse Corps from the provisions of the Defense Officer Personnel Management Act of 1981 (DOPMA) restricting the numbers of officers serving in the control grades (lieutenant commander, commander, and captain). Data from the 1987-1989 Bureau of Medicine and Surgery Information System (BUMIS) and planned accessions are used to forecast end of fiscal year grade distributions from fiscal years 1991 to 1994. The forecasts are then compared to targeted end strengths, fiscal year 1989 grade authorizations and the Navy DOPMA allowance for the control grades. The results of this analysis suggest increasing vacancies in the control grades will relieve the U.S. Navy Nurse Corps' current lieutenant commander grade imbalance and decrease the proportion of the force structure serving in the control grades.

UNIT COHESION AND THE NAVY: DOES COHESION AFFECT PERFORMANCE?

**Anthony Henry Dropp - Lieutenant, United States Navy
B.A., The Citadel, 1983
Master of Science in Management - December 1989
Co-Advisors: R. S. Elster & M. J. Eitelberg - Department of
Administrative Science**

This study was undertaken to discover whether unit cohesion is systematically related to unit effectiveness in a Navy context. To this end, correlation analysis was conducted on personnel turnover rates and several measure of effectiveness (MOE) variables from various tests and inspections on ships in the Naval Surface Force, U.S. Pacific Fleet. The MOE variables included retention rates, Supply Management Assessment scores, Maintenance and Material Management (3M) Inspection scores, Training Readiness Evaluations, and Operational Propulsion Plant Examination (OPPE) scores. The results showed few statistically significant relationships between the turnover and MOE variables. Recommendations are offered for further study on unit cohesion and its possible relationship to unit effectiveness.

**EFFECTS OF MARITAL/DEPENDENCY STATUS ON REENLISTMENT BEHAVIOR
OF SECOND-TERM ENLISTED FEMALES**

**Laura Nell Edwards - Lieutenant, United States Navy
B.A., University of Kentucky, 1981
Master of Science in Management - December 1989
Advisor: G. W. Thomas - Department of Administrative Science**

This thesis investigates the relationship of reenlistment decisions of second-term enlisted women in the military to their marital and dependent status, using individual-level data from the 1985 DoD Survey of Officer and Enlisted Personnel. Actual reenlistment status (December 1988) of each survey respondent was merged with the data set. Logit analysis was used to estimate the likelihood of a respondent choosing to reenlist given her set of individual characteristics. Separate logit models were estimated for the following groups of second-term personnel: single women without children, single women with children, married women without children, and married women with children. Certain variables affected all groups similarly (pay grade, minority status, perception of civilian job alternatives). Other exerted differential impact on subgroups (job satisfaction, traditionality of job). Results illustrated differential reenlistment behavior based on the presence of children. Results may be used to target reenlistment incentives for specified marital/dependent status groups.

ADMINISTRATION OF SERVICE CONTRACTS

**John J. Egan - Captain, United States Marine Corps
B.S., University of Idaho, 1978**

Master of Science in Management - December 1989

Advisor: R. W. Smith - Department of Administrative Science

During the Carter Administration the Office of Management and Budget Circular A-76 was brought back as an important program to reduce Government spending. This emphasis increased the number of service contracts within the Department of the Navy. This thesis looks at the administration of installation support service contracts in the Department of the Navy by dividing administration into three areas. They are: contract type and incentives, education and training of Government personnel, and the tasks involved in administration. It recommends that the present emphasis on fixed-price contracts continues, but that the Government use negotiations instead of sealed bids and contractors obtain performance bonds. Additionally, it reinforces the importance of proper preparation of the statement of work, and recommends changes to the Government education and training programs.

AN EXPERT SYSTEM FOR THE MANAGEMENT OF HAZARDOUS MATERIALS AT A NAVAL SUPPLY CENTER

**David C. England - Lieutenant Commander, United States Navy
B.S., California State University at Fullerton**

Master of Science in Management - June 1990

Advisor: A. W. McMasters - Department of Administrative Science

This thesis analyzes, designs and implements an expert system for the management of hazardous material at a Navy Supply Center (NSC). This system is part of a series of expert systems built by the Naval Postgraduate School to assist the Naval Supply Systems Command in automating its inventory management systems at NSCs. Selecting the proper storage conditions and location for newly received hazardous material requires the NSC's expert in such matters, the safety and health manager, to research the primary data base, the Hazardous Material Information System (HMIS), and any other relevant information sources, and extract pertinent information. He determines the best storage conditions for the material and passes this information to the warehouse worker. The Hazardous Material Expert System (HAZMATES) will facilitate making the storage decision and will allow warehouse worker to safely store hazardous material without the assistance of the safety and health manager. In addition, it can provide information on an item's flash point, reactivity, and disposal requirements.

AN IMPLEMENTATION OF INTEGRATED LOGISTIC SUPPORT FOR TURKISH ARMED FORCES

**Sezai Erzin - First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1982**

Master of Science in Management - June 1990

Advisor: LTC Bard Mansager - Department of Operations Research

Inadequate logistics support planning marred the major weapon systems acquisitions of the Turkish Army. Budgetary restraint emphasized the purchase of least-cost weapon systems and reduced operational and sustained readiness to secondary roles. Moreover, inadequate planning required the Turkish Army to inefficiently use additional resources to operate and maintain these systems. This thesis provides guidance allowing the Turkish Army to use a life-cycle support management plan for future weapon systems acquisitions.

ANALYSIS OF THE U.S. NAVY'S AVIATION DLR WORKLOAD FORECASTING

Cemal Esenlik - Major, Turkish Air Force

B.S., Aegean University, 1975

Master of Science in Management - December 1989

Advisor: T. P. Moore - Department of Administrative Science

This thesis examines the repair workload forecasting for depot level repairables (DLR's) managed by the Aviation Supply Office (ASO) and overhauled by Navy Aviation Depots (NAVDEPs). ASO was visited to gather actual and forecasted data on DLR repair workloads. Data was also obtained from the Navy Aviation Depot Operations Center. An analysis of policies and procedures used by ASO in preparing workload forecasts was conducted. Recommendations are made to improve the management of depot level.

A DICTIONARY OF CONTRACTING AND ACQUISITION TERMS II

Richard A. Florek - Captain, United States Army

B.S., Ball State University, 1980

Master of Science in Management - December 1989

Advisor: D. V. Lamm - Department of Administrative Science

This thesis is a continuation of research initiated by LCDR Daniel Ryan, SC, USN to establish a basis for defining words and terms used in the field on contracting. As in LCDR Ryan's thesis, this work used the methodology of selecting 25 terms for synthesis, surveying a selected group of National Contract Management Association (NCMA) Fellows for input into present definitions used in the contracting field, and synthesizing final definitions from the Fellows' input. Their feedback was used to arrive at an acceptable definition of the words and terms offered. Concurrent research in this area is being conducted by students at the Naval Postgraduate School, Monterey, California and the Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. This effort is being coordinated under the sanction of the NCMA.

AN ANALYSIS OF THE RELATIVE PRODUCTIVITY OF OFFICERS FROM DIFFERENT ACCESSION SOURCES

Michael J. Foster - Lieutenant, United States Navy

B.S., Marine Maritime Academy, 1984

Master of Science in Management - June 1990

Advisor: S. L. Mehay - Department of Administrative Science

This thesis compares the relative productivity of Naval Officers from the U.S. Naval Academy, Naval Officer Training Corps (NROTC), and Officer Candidate School (OCS). This is accomplished by creating a performance index for each individual based on officer fitness reports. The effects of commissioning source on performance are evaluated using multivariate analytical techniques. The results of the empirical analysis support the conclusion that Naval Academy graduates outperform NROTC or OCS graduates based on the measures used in this thesis. However, the magnitude of performance differences across commissioning source were small. Differences in performance were also found between year groups and for those officers who held warfare or engineering qualifications versus those who did not. It is recommended that further research be conducted on the marginal costs of each officer commissioning source to assist the Navy in making informed decisions concerning the future of commissioning programs.

A MULTIVARIATE ANALYSIS OF NAVY PHYSICIAN RETENTION

**Richard Peter Franco - Lieutenant, Medical Service Corps,
United States Navy**

B.S., Southern Illinois University, 1987

Master of Science in Management - December 1989

Advisor: G. W. Thomas - Department of Administrative Science

This thesis examines factors which influence the retention of Lieutenant and Lieutenant Commander Navy physicians with nine or fewer years of service. Logit regression was used to estimate the impact of various demographic, tenure, economic and perceptual variables on retention behavior. The data used was a merged data base which combined the responses from the 1985 DoD Survey of Officer and Enlisted Personnel with actual retention data from 1988 personnel records, data from the 1985 BUMIS Medical Officer File, and data from the 1985 Medical Economics Survey of Civilian Physician Earnings. Findings include indications that physicians who hold the rank of Lieutenant Commander, are board certified or fully trained specialists or are general medical officers were more likely to leave the service than their peers. Satisfaction with specific intrinsic and extrinsic job conditions was shown to significantly increase retention. Marital status, race, gender and the military/civilian pay ratio had no impact on retention likelihood. Policy implications, study limitations and recommendations for further research are also discussed.

THE COMPTROLLER'S ROLE IN FACILITIES MANAGEMENT

James P. Gerner - Lieutenant, Civil Engineer Corps, United States Navy

B.S., University of Missouri, 1981

Master of Science in Management - June 1990

Advisor: G. Eberling - Department of Administrative Science

This thesis examines the role of the comptroller in the area of facilities management. Though Facilities Management is often the largest consumer of operational resources handled by the comptroller, this field has historically been left strictly to the control of staff officers of the Civil Engineer Corps. The fiscal climate of the 1990s will reward line managers who are able to work in partnership with their facilities managers. This thesis provides a framework of understanding on which such a partnership can be built.

RECONCILIATION OF TRAVEL ADVANCES AND TRAVEL LIQUIDATIONS

Domingo Gonzales - Lieutenant, United States Navy

B.S., Texas A&I University, 1976

Master of Science in Management - June 1990

Advisor: J. M. Fremgen - Department of Administrative Science

This thesis was an investigation of the causes that prevented the matching of the accounting line associated with an advance travel payment with the accounting line associated with the liquidation payment or collection for shore activities serviced by the Fleet Accounting and Disbursing Center Pacific, San Diego, CA. Utilizing a random sample of 179 standard document numbers from fiscal year 1989, the research concluded that the two major causes preventing the matching of an advance to the liquidation were document type code errors and execution code errors. Both types of errors are attributable to input error. The research identified manual inputs, multiple activity processing and inadequate management reports as the three major barriers affecting the travel reconciliation process. Recommendations designed to prevent input errors and to improve the travel accounting process were provided.

OPTICAL STORAGE SYSTEM FOR SHIPBOARD SUPPLY DOCUMENTS

Richard C. Gottlick - Lieutenant, Supply Corps, United States Navy

B.S., University of Maryland, 1977

and

Edwin A. Victoriano - Lieutenant, Supply Corps, United States Navy

B.S., University of the East, 1972

Master of Science in Management - December 1989

Advisor: T. P. Moo - Department of Administrative Science

This thesis attempts to find a better alternative to the manual storage of material issue and receipt documents on the Navy's aircraft carriers and submarine tenders. The objectives were to develop a system that would significantly reduce the labor time required to file the documents, reduce the required storage volume, increase file accuracy, and increase access to file information. Alternatives using current document storage technology were analyzed. A PC-based optical document storage and retrieval system is proposed as the optimum alternative.

PROCUREMENT MANAGEMENT REVIEWS; AN ANALYSIS OF THE MOST RECURRING DISCREPANCIES FOR SMALL PURCHASE OPERATIONS

Basil F. Gray, III - Lieutenant, United States Navy

B.S., Jacksonville University, 1980

Master of Science in Management - June 1990

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

Various Naval Field Activities are granted procurement authority from the Naval Supply Systems Command (NAVSUP) or Naval Regional Contracting Centers (NRCC). The granting activities (NAVSUP or NRCC) are required to do periodic reviews of these activities in order to ensure that the rules, regulations and proper procedures are being followed. During these Procurement Management Reviews (PMR) many of the same discrepancies continue to appear. This thesis analyzes 50 PMRs conducted by NRCC, San Diego, in 1989. It reveals 16 common discrepancies, discusses why buyers and reviewers felt they occurred and recommends actions that will reduce their occurrence.

A STUDY OF APPROVAL PLANS AND THE GOVERNMENT'S ABILITY TO CONTRACT FOR THEM UNDER THE FEDERAL ACQUISITION REGULATION (FAR)

David B. Grove - Lieutenant Commander, United States Navy

B.S., University of Minnesota, 1977

Master of Science in Management - December 1989

Advisor: P. M. Carrick - Department of Administrative Science

The primary objective of this thesis is to assess the use of approval plans in the procurement of monographs for Department of Defense Libraries. The intent of the study was to identify the present procurement methods and to investigate the applicability of approval plans under the Federal Acquisition Regulation (FAR). The research was conducted by a review of current literature and interview with acquisition and collection development librarians. Conclusions and recommendations with regard to approval plans are provided along with procedural methods for implementing approval plans under current Department of Defense regulations.

**A COMPARISON OF THE MANAGERIAL CHARACTERISTICS OF MID-GRADE
NAVY UNRESTRICTED LINE OFFICERS**

**Lois Helen Gruendl - Lieutenant Commander, United States Navy
B.S., Marquette University, 1978**

Master of Science in Management - December 1989

**Co-Advisors: R. S. Elster & B. J. Roberts - Department of
Administrative Science**

The Navy currently has a fully fledged occupational database for all enlisted ratings in pay grades E-1 through E-9 but no complementary, comprehensive database for its officers. There are several reasons for this, including the Navy's desire that its line officers' responsibilities not be too narrowly defined. The Navy wants its officers to be well-versed in many areas, ready and willing to take on new and challenging assignments. Another reason is the Navy's focus on the military leader rather than the military manager. Both aspects are part of the professional naval officer, however, and should be given equal weight in the occupational research arena. The purpose of this thesis is to examine the managerial characteristics of mid-grade Unrestricted Line officers to determine whether there are discernible differences by designator and pay grade. It is hoped that defining these differences and similarities will be of value in managing job classification, staffing qualifications, training requirements, and job performance of Navy officers.

**THE IMPLICATIONS OF THE CHANGES IN THE SOVIET UNION AND EASTERN EUROPE ON
NATO-WARSAW PACT RELATIONSHIP AND THE U.S. DEPARTMENT OF DEFENSE BUDGET**

Richard Guerrero - Lieutenant, United States Navy

B.A., Valparaiso University, 1978

Master of Science in Management - June 1990

Advisor: L. R. Jones - Department of Administrative Science

The thesis reviews the changes in the Soviet Union and Eastern Europe; analyzes their affect on Western security; and assesses the United States Department of Defense's possible options in terms of forces and budget. The main findings are: (1) The Warsaw Pact threat to NATO and the United States has been significantly reduced. (2) The future of European security centers on the issue of Germany. (3) A new mission for NATO is needed which will reflect a greater emphasis on NATO's political capabilities. As East-West confrontation recedes and the prospects for East-West cooperation advance, NATO can contribute to meeting the new challenges and helping in determining the path for the evolution of European and Atlantic security. (4) The United States must revise the military budget to seize the opportunities presented by the events in 1989 and, at the same time, maintain a military capable of defending our interests and meeting the uncertainties of the future. The true challenge for future military budgets will be to use the international opportunity to save money in a sensible manner that matches defense spending with military strategy.

THE IMPACT OF TECHNOLOGICAL CHANGE ON MILITARY MANPOWER IN THE 21ST CENTURY

Neale D. Guthrie - Captain, Royal Australian Engineers

B.E., University of New South Wales, 1982

Master of Science in Management - June 1990

Advisor: G. W. Thomas - Department of Administrative Science

This thesis analyzed the impact of technological change on military manpower in the future. The scope of the study was very broad in an attempt to capture the wide range of social, economic, organizational and psychological affects that technological change is expected to bring. The review of the literature was divided into four sections: general, discipline-specific, civilian sector forecast, and military forecasts. The general section reviewed popular Futurists and authors who have focused on the broad effects of technological change. The discipline-specific section reviewed the theory of technological change within four specific areas: economics, sociology, organizational theory, and psychology. The civilian sector forecast reviewed labor forecasts for the year 2000 and specific industry forecasts for various industries. The military literature review was structured under policy, the future battlefield, manpower, technology, military medicine, and the defense industry headings. The literature was then synthesized to reveal several dominant trends in society, work, and the military that results from technological change. These trends include: shifts in the occupational structure towards white-collar employment; an increase in the average educational quality of the future workforce, decentralized, smaller scale organizations; and movements towards the electronic battlefield. Finally these trends were developed into a possible scenario for 2025. The scenario was presented in three parts: the environment, civilian forecast, and the military forecast. Conclusions from the scenario that will impact defense policy included: force reductions, high quality personnel requirements, several personnel issues, and increased requirements for training.

AN ANALYSIS OF THE FACTORS AFFECTING THE CAREER ORIENTATION OF JUNIOR MALE U.S. ARMY OFFICERS

Tae Hwan Ha - Major, Republic of Korea Army

B.A., Korea Military Academy, 1981

Master of Science in Management - December 1989

Advisor: G. W. Thomas - Department of Administrative Science

This thesis developed a model to assess the effects of factors influencing the career orientation of junior male Army officers using the Army portion of the 1985 DOD Officers and Enlisted Personnel Survey Member File. Junior officers were classified as early juniors or late juniors according to their length of service (four months to four years and five to ten years). A multivariate logit regression model was estimated utilizing explanatory variables which were classified into demographic/ personal, environmental, intrinsic or extrinsic categories, to explain career orientation (plans to serve twenty years or more). The results indicate that demographic factors (length of service, commissioning sources) and intrinsic factors (personnel freedom, friendship, co-workers, patriotism, job satisfaction, job training, job security and working conditions) have strong effects on the career orientation of both levels of junior officers. Further, early junior officers are affected by the package of retirement benefits and late junior officers are affected by factors related to family. This study shows that expressed intentions of members can be used as valid indicators of later behavior based on the closeness of the match between intentions and actual behavior. This study should provide guidelines for personnel managers and policy makers to maintain targeted strengths of junior officers.

**AN EVALUATION OF THE NAVY'S RED YELLOW GREEN PROGRAM AND HOW THIS PROGRAM IS
INTENDED TO IMPROVE THE SELECTION OF QUALITY CONTRACTORS**

**Krista Ann Hagmann - Lieutenant, Supply Corps, United States Navy
B.S., United States Naval Academy, 1982**

Master of Science in Management - December 1989

Advisor: E. N. Hart - Department of Administration Science

The Navy is currently testing a new source selection tool known as Red Yellow Green (RYG). RYG helps field contracting activities obtain the best purchase value by adding the costs of poor contractor performance into the source selection equation. The program should improve the quality of material received by the Government and the performance of Government contractors. RYG can be used in conjunction with Blue Ribbon Contractor programs and moves field contracting activities toward Total Quality Management implementation.

A FINANCIAL DECISION SUPPORT SYSTEM FOR U.S. NAVY PUBLIC WORKS DEPARTMENTS

S. Keith Hamilton - Lieutenant, Civil Engineer Corps, United States Navy

B.S. - Ch.E., University of Missouri, 1983

Master of Science in Management - December 1989

Advisor: S. S. Liao - Department of Administrative Science

To date, most efforts for developing microcomputer based financial applications for small Navy public works departments (PWD's) has occurred using an ad hoc approach, database management software, and independent user development. Recent technological advancements in computer hardware and software provide a cost efficient method of improving the effectiveness of financial decision making in PWD's. This thesis addresses two primary research questions: (1) Can a generally applicable model for financial accounting and reporting be developed for PWD's using a commercially available decision support system generator such as Lotus 1-2-3? (2) Can such a model be used to apply decision support system theory to financial management within the PWD? In this thesis, Lotus 1-2-3 Release 3.0 was used to develop a microcomputer based financial accounting and reporting model for PWD's. A small test data set was used to demonstrate the model and illustrate its use as a decision support system. The software developed in this thesis is available from the thesis advisor upon request.

**SOURCES OF JOB SATISFACTION AND DISSATISFACTION
AMONG MID-GRADE COAST GUARD OFFICERS**

James Matthew Hasselbalch - Lieutenant Commander, U.S. Coast Guard

B.S., United States Coast Guard Academy, 1976

Master of Science in Management - June 1990

Advisors: R. A. McGongial & K. W. Thomas - Department of Administrative Science

This study replicates a survey that was done in 1983 which identified sources of job satisfaction and dissatisfaction among U.S. Coast Guard officers in the grades of Lieutenant, Lieutenant Commander, and Commander. The results from the current survey are compared with the previous survey's results and statistically significant changes in the levels of satisfaction and dissatisfaction are analyzed. In general, levels of satisfaction with intrinsic sources of motivation remained high in both surveys while levels of satisfaction with extrinsic sources of motivation, such as pay and promotion, declined in the current survey. Recommendations are made for improving job satisfaction among these officers.

**AN INVESTIGATION OF THE QUALITY EARNINGS CONCEPT AS
APPLIED TO DEFENSE CONTRACTORS**

Todd Allen Hauge - Lieutenant, United States Navy

B.S.M.E., United States Naval Academy, 1983

Master of Science in Management - December 1989

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

This thesis analyzes whether the quality of earnings concept can be usefully employed in the security analysis of defense contractors. Background is provided by an extensive review of the literature relevant to quality of earnings. Since the quality of earnings concept is very subjective, specific quantitative measures of quality of earnings are developed and used in a statistical analysis to validate the variables as explanatory predictors of a firm's price earnings (P/E) ratio. The statistical techniques employed include Pearson's Product Moment Correlation, Spearman's Rank Order Correlation, stepwise regression and other multiple linear regression models. Results of the study suggest that there are significant relationships between several hypothesized quality of earnings variable and a firm's P/E ratio. The statistically significant variables in the final regression models explain between 67.8% and 76.6% of the variation in the P/E ratio. The evidence indicates that variables related to case flow, degree of government business, order backlogs and earnings stability reflect aspects of a firm's quality of earnings.

**A FIELD STUDY OF CONTROL SYSTEMS IN ENVIRONMENTS WITH ILL-
DEFINED TECHNOLOGY AND OUTPUT**

Robert Charles Hayden - Lieutenant, United States Coast Guard

B.S., United States Coast Guard Academy, 1978

and

Michael Francis Query - Lieutenant Commander, Supply Corps,

United States Navy

B.A., College of the Holy Cross, 1977

and

Graham Thomas Shipley - Lieutenant Commander, United States Navy

B.A., University of Virginia, 1978

and

Leonard Alexander Snead II - Commander, United States Navy

B.B.A., George Washington University, 1971

M.S.S.M., University of Southern California, 1982

Master of Science in Management - December 1989

Advisor: K. J. Euske - Department of Administrative Science

The purpose of this study is to investigate how resources are controlled in environments with ill-defined technology and output. Of interest is whether such profit and nonprofit organizations have similar control structures and processes. Organizations in three different industries were investigated: child care, information services, and fire protection. The study provides a basis to develop and understand control processes in the specific environments studied.

**THE MARINE CORPS SERVICE PLANNING PROCESS-THE CONTINUAL
FORGING AND TEMPERING OF THE SWORD**

**Terry Lee Hilliker - Major, United States Marine Corps
B.A., University of Hartford, 1975**

and

**William Steven Jesson - Captain, United States Marine Corps
B.A., Cornell University, 1982**

Master of Science in Management - December 1989

Advisor: N. C. Roberts - Department of Administrative Science

This thesis will examine, describe, and analyze the Marine Corps service planning process to determine the extent that it is strategic and effective. It will begin by reviewing the various terminology associated with strategic management. This will be followed by a synopsis of military structures and processes, as well as the external and internal influences which make up the ever changing backdrop for the Marine Corps service planning process. Finally, the Marine Corps service planning process, which encompasses the informal and formal processes that steer the actions, thinking, and planning efforts of the Marine Corps, will be described and analyzed to determine its strategic value and effectiveness.

**COST EFFECTIVENESS OF CIVILIAN-RUN OUTPATIENT CLINICS IN THE NAVAL HOSPITAL OAKLAND
AND SILAS B. HAYS ARMY COMMUNITY HOSPITAL CATCHMENT AREAS**

**Margaret G. Hodun - Lieutenant, Medical Service Corps
United States Naval Reserve
B.S., Alfred University, 1980**

and

**Edward J. Wood - Lieutenant, Medical Service Corps, United States Navy
A.A., George Washington University, 1982**

B.S., University of the State of New York, 1982

M.A., Central Michigan University, 1982

Master of Science in Management - December 1989

Advisor: S. S. Liao - Department of Administrative Science

Rising health care costs coupled with ever increasing CHAMPUS use have spawned the creation of a number of corrective programs. The civilian-run outpatient clinics (NAVCARE in the Navy, PRIMUS in the Army) are one such effort to curb health care costs by contracting outpatient services to private corporations. It is hoped that these clinics will attract patients away from the CHAMPUS program by offering a wide range of free primary and preventive care services to dependents and retirees. This thesis will examine the civilian-run outpatient clinics in the Naval Hospital Oakland and Silas B. Hays Army Community Hospital catchment areas to evaluate their success in expanding availability of services while maintaining a cost effective edge over Military Treatment Facilities and CHAMPUS.

THE CRITERIA FOR AND EFFECTS OF BASE CLOSURES

**Glenn Anthony Holk - Lieutenant, United States Navy
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Master of Science in Management - December 1989

Advisor: J. M. Fremgen - Department of Administrative Science

This study examines available information on base closures. A determination is made as to the criteria for and the effects of these closures. The criteria developed include costs to the federal government, local economic impact, political impact, environmental impact and the impact on defense readiness. There were few detailed data available on the criterion of costs to the federal government. The majority of the information came from GAO evaluations of DOD proposals to close or realign bases. There were more data available on the criterion of local economic impact, the majority of these data coming from the Office of Economic Adjustment. Some data were available on the remaining criteria, but they were mostly based on personal opinions. The analysis attempts to draw lessons from past base closures to assist in the assessment of future closure decisions. However, the limited data provided little conclusive evidence to support the criteria for decision making.

**A STRUCTURE AND DATA BASE FOR ANALYZING THE TRAINING SCHOOL
PERFORMANCE OF HISPANIC-AMERICAN ENLISTEES IN THE NAVY**

James Vincent Jarvis - Lieutenant, United States Navy

B.S., University of South Carolina, 1983

and

Robert James Gaines - Lieutenant, United States Navy

B.S., Colorado State University, 1982

Master of Science in Management - December 1989

Co-Advisors: M. J. Eitelberg & A. M. Crawford -

Department of Administrative Science

The purpose of this thesis was to create a structure for analyzing the training school performance of Hispanic-American enlistees in the Navy. This was accomplished by developing a computerized data base, utilizing an extract of the Navy Enlisted Classification Tracking file (NECTRACK) and the Enlisted Training Tracking file (TRAINTRACK), supplied by the Navy Personnel Research and Development Center. In addition, a review of literature was undertaken to provide a summary of available information on factors that may influence the performance of Hispanic-Americans in the Navy. Finally, the data base was explored by conducting a preliminary analysis of the relationship between selected training outcomes and the educational level of Hispanic sailors. Several recommendations are offered concerning the application of the data base and the treatment of research variables. In addition, further study is recommended using the data set developed for this thesis.

**CURRENT STATUS OF BLANKET PURCHASE AGREEMENT USAGE
WITHIN MARINE CORPS FIELD CONTRACTING ACTIVITIES**

William Javoroski - Captain, United States Marine Corps

B.S., Michigan State University, 1978

Master of Science in Management - June 1990

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

This thesis examines the use of Blanket Purchase Agreements (BPA's) by Marine Corps field contracting activities. This research examines the regulations regarding the use of blanket purchase agreements and to what extent blanket purchase agreements are used by Marine Corps field contracting activities. Benefits and problems associated with the use of blanket purchase agreements are analyzed to determine if any improvements can be made.

**THE FINANCIAL IMPACT OF THE DEFENSE MESSAGE SYSTEM
(DMS) ON NTCC MONTEREY AND ITS SUBSCRIBERS**

JoAnn Joganic - Lieutenant Commander, United States Navy

B.A., Saint Mary-of-the-Woods College, 1973

Master of Science in Management - June 1990

Advisor: S. S. Liao - Department of Administrative Science

The Defense Message System (DMS) is the target communication architecture destined to replace the Automatic Digital Network (AUTODIN). Designed to permit message delivery between office workstations, this system provides DMS managers with the opportunity to cut electronic communication costs and realign assets within a geographical area. This thesis overlays the planned DMS architecture on the Naval Telecommunications Center (NTCC) Monterey, CA, and analyzes the economic impact of DMS on the center and the 17 subscribers it serves. Using a five year projection and net present value theory, it demonstrates a cost avoidance of \$492,899 if the communications center undergoes an equipment upgrade and a \$1,885,631 avoidance if the NTCC is closed.

**COST ANALYSIS OF TWO METHODS OF INSTRUCTION
IN P-3 FLEET REPLACEMENT SQUADRONS**

**David M. Johnshoy - Lieutenant Commander, United States Navy
B.S., Metropolitan State College, Denver, 1978
Master of Science in Management - June 1990**

Advisors: L. Gorman & A. M. Crawford - Department of Administrative Science

In 1979, a P-3 aircrew training program, designed using the Instructional Systems Development process, was implemented in the two P-3 Fleet Replacement Squadrons. One squadron adopted workbooks recommended by ISD, one continued with lectures. This thesis compares the cost differences arising from two different methods of instruction now in use in P-3 training programs. A conceptual model is developed to compare the opportunity costs associated with the selection of one training method over another. The results indicate that the lecture method of instruction is least costly.

PLANT GROWTH REGULATORS: AN ALTERNATIVE TO FREQUENT MOWING

**Robert Jean Johnson - Lieutenant, United States Navy
B.S., North Dakota State University, 1981
Master of Science in Management - June 1990**

Advisor: P. M. Carrick - Department of Administrative Science

The focus of this thesis is to determine if the application of Plant Growth Regulators (PGR's) to frequently mowed semi-improved areas can minimize the total annual mowing costs at Naval Air Station Cecil Field, Florida and Naval Air Station Jacksonville, Florida. The highest potential savings are in areas where the frequency of mowing is weekly or biweekly. In areas where the mowing frequency is one time per month, the savings approach a breakeven. The results indicate considerable cost savings can be realized at both naval air stations if a well-planned PGR application program is implemented.

**A PRACTICABILITY STUDY ON THE DEVELOPMENT OF A
STANDARD, STAND-ALONE COMPUTERIZED CONTRACT
PRICING MODEL FOR CONTRACT PRICING AND NEGOTIATIONS**

**Jonathan L. Katz - Captain, United States Marine Corps
B.S., Montclair State College, 1982
Master of Science in Management - June 1990**

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

This thesis examines the practicability of developing a standard, stand-alone, computerized contract pricing model for contract pricing and negotiations. A functional description of a proposed contract pricing model is provided. The results of data collected from a survey of DLA, Navy, and Marine Corps field contracting activities are examined and the practicability of developing such a model is analyzed.

SURFACE WARFARE ATTRITION: DOES SHIP TYPE MAKE A DIFFERENCE?

William James Kear - Lieutenant Commander, United States Navy

B.S., United States Naval Academy, 1977

Master of Science in Management - December 1989

**Co-Advisors: R. S. Elster & M. J. Eitelberg - Department of
Administrative Science**

This thesis seeks to determine if there is a relationship between ship type and first-term enlisted attrition in the Surface Warfare Navy. The data used in this thesis were taken from the Department of Defense (DOD) Enlisted Master Record (EMR:). Information on male sailors aboard ships with 33 months or less of completed service was extracted from the EMR. Three cohorts were examined--those who joined their first ship in fiscal 1977, 1981, and 1985 respectively. A total of 77, 502 personnel serving in 300 ships were analyzed in three data formats: individual ship, ship class, and ship mission category. The results revealed wide variation in attrition rates between individual ships and respective ship classes across different cohorts. In addition, a distinct trend in attrition was observed between ships in different mission categories. For example, oilers generally had the highest rate of attrition across all three cohorts--followed (in order) by amphibious ships, minesweepers, and repair ships with cruisers, destroyers, and frigates having the lowest rate. Further research is recommended to determine the causes for differences in attrition between ship types. Understanding this aspect of enlisted attrition may further aid Navy manpower planners and leaders in reducing personnel attrition and its consequences for the Surface Warfare Navy.

COAST GUARD STRATEGIC MANAGEMENT: LAW ENFORCEMENT IN THE 1990'S

Brian D. Kelley - Lieutenant, United States Coast Guard

B.S., U.S. Coast Guard Academy, 1982

Master of Science in Management - June 1990

Advisor: R. D. Evered - Department of Administrative Science

The purpose of this study is to examine how the United States Coast Guard develops and manages its law enforcement mission. The author analyzes the Coast Guard's strategy development in its maritime law enforcement mission. Specifically, the thesis starts with a review of the strategy concept and attempts to answer what strategy is, what a strategist is, and what is strategic planning. Secondly, this study cites four factors (the organizational culture, public opinion, the law enforcement mission role, and expectations) that will significantly influence Coast Guard law enforcement strategy in the 1990's. Finally, the author addresses the current Coast Guard law enforcement strategy from its formulation to its execution.

A COST ANALYSIS FOR DECIDING SERVICE LEVELS IN KOREAN ARMY WITH A CONSTRAIN FOR SINGLE PERIOD

Yoo Choong Keun - Major, Republic of Korea Army

B.S., Korea Military Academy, 1981

Master of Science in Management - June 1990

Advisor: D. Trietsch - Department of Administrative Science

Since the Korean War, there has been a fierce military competition between Republic of Korea (ROK) and the Democratic People's Republic of Korea (DPRK). The DPRK has committed over 10 percent of its GNP since 1963 to defense expenditures, whereas, the ROK has spent a relatively small portion (3-6 percent) of GNP over the same period. Because the U.S. plans to withdraw from the ROK in the near future, a heavy burden will be imposed upon ROK Government to maintain its national defense. The U.S. withdrawal will results in the delay of achieving a military balance in the Korean Peninsula. Under these conditions, it becomes essential to find the most efficient allocation of the defense budget so as to get the most high-tech weapons, and achieve military balance with the DPRK at the soonest possible time. The purpose of this thesis is to compute the service levels for critical items with the present budget, and to determine whether the budget is used effectively in the ROK Army. To solve the problem, the cost analysis method is utilized. An application of this methodology is shown with an illustration. This analysis shows that different items call for different service levels.

**STRATEGIC GUIDE TO NATURAL DISASTER PLANNING, PREPAREDNESS,
RESPONSE, AND RECOVERY FOR NAVAL SUPPLY CENTER, OAKLAND, CALIFORNIA**

**Christopher T. Kibler - Lieutenant Commander, United States Navy
B.S., The Citadel, The Military College of South Carolina, 1976
and**

**James L. Kerber - Lieutenant, United States Navy
B.S., University of California, Berkeley, California, 1980
Master of Science in Management - June 1990**

Advisor: T. P. Moore - Department of Administrative Science

The specific goal of this thesis is to provide a strategic guide which can be used as a basis by Naval Supply Center (NSC), Oakland, California to formulate a natural disaster planning, preparedness, response and recovery program. The objective of such a program is to reduce the amount of damage caused by a natural disaster, enable effective response to a disaster and facilitate recovery. The plan must be consistent with the supply center's priorities and be within budget limitations. Further, the plan must address additional areas such as supporting other defense activities and responding to taskings from the Federal Emergency Management Agency (FEMA).

**AN ANALYSIS OF TANK GAP IN MILITARY BALANCES BETWEEN REPUBLIC
OF KOREA AND NORTH KOREA**

**Dong Hui Kim - Captain, Republic of Korea Army
B.A., Korea Third Military Academy, 1986**

Master of Science in Management - December 1989

Advisor: R. A. McGonigal - Department of Administrative Science

At present, some analysts advocate (both ROK and U.S.) a reduction or withdraw of U.S. troops from the Korean Peninsula and a return of all the rights of command to the ROK government. This will increase the risk of another war on the Korean Peninsula. If war were to break out, Korea might be devastated economically, returning the people to the poverty levels of 1953. Also, war on the Korean Peninsula might lead to, or precipitate, another World War because the powerful allied nations (both U.S. and USSR) would participate in that war. Therefore, peace on the Korean Peninsula is very important and can be achieved if the ROK and NK perceive each other as possessing balanced military strength. NK currently has superior military strength. So to maintain peace, if the U.S. were to withdraw, it would be necessary for the ROK government to increase defense spending. The purpose of this thesis is to identify the tank gap as a major of military strength and provide some ideas to the ROK government for the military equipment modernizing plan. This thesis provides numerical quantitative assessment of the current balance of tank forces between the ROK and NK, as well as a dynamic assessment using the Lanchester combat model.

FINANCIAL MANAGEMENT TRAINING FOR NAVY ASHORE COMMANDS

**Dean M. Kiyohara - Lieutenant Commander, United States Navy
B.A., University of California at Berkeley, 1979**

Master of Science in Management - June 1990

Advisor: G. D. Eberling - Department of Administrative Science

This thesis discusses the formal training courses and programs which are currently available to Operations and Maintenance, Navy (O&M,N) funded ashore command financial management accounting and budgeting personnel. It examines and analyzes the importance of training with respect to job performance and discusses the types of formal training programs which are needed to meet the job responsibilities of financial management accounting and budgeting personnel. In addition, the thesis reviews the current working environment of Navy ashore financial management training courses, insufficient numbers of qualified instructors and the need for additional financial management training materials. The study identifies recommendations for specific problem areas and recommends a financial management curriculum review.

CIVILIAN SUBSTITUTION FOR MILITARY PERSONNEL: AN ANALYSIS OF THE ISSUE

Bahadır S. Kose - First Lieutenant, Turkish Army

B.S., Turkish Military Academy, 1981

Master of Science in Management - June 1990

Advisor: M. J. Eitelberg - Department of Administrative Science

Efficient manpower utilization is essential to minimizing the cost, and a key element in that is the maintenance of the optimum balance between civilian and military manpower resources. Economic efficiency dictates that as the cost of military personnel begin to rise relative to the cost of direct hires, the Services would have an incentive to increase the use of direct hires, and vice versa. In our empirical analysis, results indicate that although DoD responded correctly to factor price changes measured in current dollars, DoD did not respond to changes in the real price of Civilians. It should have substituted military personnel for civilians as the real price of civilians increased. In addition to the data analysis, this research reviews the issues on the concept of military-to-civilian conversions, determines the advantages and disadvantages of such conversions, examines the associated factors and their impact, and investigates the premise that such conversion could be detrimental to the military's mission even though they may be cost-effective.

A HISTORY OF DEFENSE REFORM SINCE 1970

Michael J. Leahey - Major, United States Marine Corps

B.A., Muskingum College, 1973

Master of Science in Management - December 1989

Advisor: N. C. Roberts - Department of Administrative Science

This thesis develops a history of Defense Reform from 1970 to the present and attempts to demonstrate a linkage between concept generation and the outcomes of subsequent policy formulation. The origins of Defense Reform are examined beginning with developments and prominent personalities of the immediate post Vietnam War period and continuing to the present. In examining these developments, significant events are noted along with publications pertinent to the event. The results indicate that the phenomenon of defense reform has had a significant effect on the Defense Department's structure and policy. However, the full results of that effect cannot be completely determined due to the limitations of time and sources available for this study.

A MULTIVARIATE ANALYSIS OF THE FACTORS AFFECTING THE RETENTION OF FIRST AND SECOND TERM AIR FORCE ENLISTED MEMBERS

Scott James Lempe - First Lieutenant, United States Air Force

B.S., Chapman college, 1986

Master of Science in Management - December 1989

Advisors: L. Solnick & L. Gorman - Department of Administrative Science

The purpose of this thesis was to identify the factors influencing voluntary retention behavior of first and second term Air Force enlisted members. Further, how those factors tended to differ across term of service and occupational group was examined. Data were extracted from the 1985 DOD Survey of Officer and Enlisted Personnel. Explanatory variables were grouped into tenure, demographic cognitive and economic categories. Logit models were estimated for each term of service and occupational sub group. The results show that the factors affecting retention do tend to differ across term and occupation. Some, like overall satisfaction, were significant to everyone, while others, such as SRB, changed from one group to the next. Recommendations regarding future policy implications were made along with several recommendations for future research.

**AN ANALYSIS OF NAVAL OFFICER ACCESSION SUPPLY:
HISTORICAL FACTORS AND FUTURE TRENDS**

**Franz-Josef Lenssen - Lieutenant Commander, German Navy
M.B.A., Bundesweher Universitaet, Hamburg 1976
Master of Science in Management - June 1990**

Advisor: S. L. Mehay - Department of Administrative Science

This thesis identifies and analyzes labor market, economic, demographic, and geopolitical factors and trends which are believed to be important to officer accessions. A basic officer supply is derived from an occupation choice model. The study specifies three different measures of officer supply: applications, new contracts, and accessions. Log-linear regression models using these three dependent variables are then estimated with ordinary least squares techniques. A basic hypothesis was that application would be a more accurate measure of actual manpower supply, since new contracts and accessions are demand constrained. The empirical results, however, rejected this hypothesis. Nonetheless, the results indicate that officer supply is affected by some economic variables, in particular civilian wages. In a second step, the basic officer supply models are estimated for specific officer programs such as nuclear officers, nurses, medical officers, and the entire medical corps. The estimated regression equations for the separate programs were not sufficiently robust to allow accurate forecasting. Possible causes for the inadequate results are discussed.

THE INTERNAL CONTROL SYSTEM AND CONTROL PROGRAMS: A REFERENCE GUIDE

**Debra A. Lewandowski - Lieutenant, United States Navy
B.S., University of Michigan, 1978**

Master of Science in Management - June 1990

Advisor: G. Eberling - Department of Administrative Science

This thesis was designed as a reference guide for managers, specifically Commanding Officers and Comptrollers, concerning the internal control system and control programs. It provides a general overview of the internal control system and discusses the various external and internal audits, inspections, reviews and *investigative organizations and programs*. The thesis defines the audit system and includes audit standards and the audit process. Practical guidelines for preparing for and participating in audits or inspections are included. An additional reading list of relevant directives and instructions governing the various programs and agencies is intended as a central resource for managers to obtain additional information.

**A COMPARATIVE ANALYSIS OF FACTORS AFFECTING THE CAREER
ORIENTATION OF NAVAL OFFICERS AND FEDERAL CIVILIAN ENGINEERS**

**Thomas Edward Lindner - Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1977**

**Master of Science in Management - December 1989
and**

**Mark Edward Davis - Lieutenant, United States Navy
B.S., United States Naval Academy, 1983**

Master of Science in Management - March 1990

**Co-Advisors: B. J. Roberts & K. W. Thomas - Department of
Administrative Science**

This thesis examines factors that affect the career orientation of the United States Navy Surface Warfare and Submarine designated officers and federally employed civilian engineers and scientists at the Naval Avionics Center. Biodemographic, tenure, satisfaction, and expectations-related variables were tested for correlation with intent to remain in the organization for the period of service corresponding to the derived definition of "career." The results were used to construct models for each of the above sample groups and the Logit regression procedure was used to measure the impact of each retained variable on career intent. Data for the military samples were taken from the 1985 DOD Survey. Data for the Naval Avionics Center sample were collected using a survey designed and administered by the authors. The thesis identifies different behavior patterns between the three samples. Additionally the thesis provides insight as to the relative and comparative impacts of the factors deemed significant and their potential influence on retention policy.

**THE EFFECT OF PROVIDING ON-SITE CHILD CARE SERVICES
ON PERSONNEL PRODUCTIVITY, MORALE, AND RETENTION**

Diane L. H. Lofink - Lieutenant Commander, United States Navy

B.A., Rosary College, 1978

Master of Science in Management - June 1990

Advisor: M. J. Eitelberg - Department of Administrative Science

This thesis investigates the possible impact of on-site child development centers on the productivity, morale, and retention of Naval officers and enlisted personnel. A written survey was conducted of active duty personnel with dependents under age 13, assigned to eight Navy shore installations, four of which offer on-site child care and four of which do not. Approximately 39 percent of the respondents reported experiencing child care-related work interference, regardless of marital status or command type. Personnel at commands without on-site child care reported higher rates of several types of work interference. Of the 30 percent of respondents who reported that their child care experiences had influenced their decision to remain in the Navy, by a ratio of 2 to 1, they were more likely to leave than remain on active duty. However, statistical analyses conducted while controlling for other factors suggest that on-site centers do not significantly increase or decrease the probability of either work interference or career influence.

PERSONNEL AND PAYROLL MANAGEMENT; A GUIDE FOR THE COMPTROLLER

Raymond K. Lofink - Lieutenant Commander, United States Navy

B.A., Washington State University, 1976

Master of Science in Management - June 1990

Advisor: G. Eberling - Department of Administrative Science

The focus of this thesis is to identify the prerequisite knowledge required by the Navy financial manager in the budget formulation and execution process for civilian personnel and payroll management. Research at the field activity level has provided practical policies and procedures that have been combined with existing financial management directives, manuals, and instructions to produce a management guide for incorporation in the Practical Comptrollership Course (PCC) offered by the Naval Postgraduate School in Monterey, California. It is primarily intended for use by the PCC students as a management tool for relieving, reference and training.

COMPONENT BREAKOUT POLICY AND GUIDANCE WITHIN THE DEPARTMENT OF DEFENSE

Joseph F. Manna - Lieutenant, United States Navy

B.S., University of West Florida, 1980

Master of Science in Management - June 1990

Advisor: R. W. Smith - Department of Administrative Science

This study was undertaken to examine and analyze the current policy and guidance governing the component breakout program as it is currently structured within the Department of Defense (DOD). Issues related to the adequacy and standardization of component breakout policy and guidance were addressed, and an overview of the component breakout by the audit community. The research methodology consisted of an extensive literature review, a comprehensive analysis of written DOD (and individual Service) policy and guidance, and personal interviews of senior DOD acquisition personnel. During the course of this study, it was found that: (1) there is adequate DOD level guidance on the component breakout program; (2) qualitative factors are not adequately considered in the component breakout decision making process; (3) administrative requirements of the DFARS regulation on component breakout are generally disregarded by acquisition managers; (4) the audit community perceives the existence of a series compliance problem with the component breakout program; and (5) Program Managers (and their chain of command), rather than the audit community, are the more appropriate authority to make judgments in favor of component breakout.

**AN ANALYSIS OF SOURCE SELECTION PROCEDURES FOR ENGINEERING
SUPPORT SERVICES CONTRACTS**

Kenneth D. Marsh - Lieutenant, United States Navy

B.A., North Carolina State University, 1979

Master of Science in Management - December 1989

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

The purpose of this thesis is to identify and discuss the key preaward problems encountered in engineering support services contracts and how these problems might be avoided in order to improve the contracting process. The research was conducted by a review of directives and policy guidance, field interviews with Government and Defense Industry personnel, and visits with key individuals involved in source competition and selection initiatives. The intent of study was to analyze source selection criteria, ascertain problems and issues encountered, and make recommendations that offer viable solutions to the contract award process. This study also recommends areas for future study that may provide insight into improving the engineering support services contracting process.

**A LEAST COST STUDY FOR BOOK PROCUREMENT AT
THE NAVAL POSTGRADUATE SCHOOL LIBRARY**

Patrick J. McCarthy, Jr. - Lieutenant Commander, United States Navy

B.S., Iowa State University, 1978

Master of Science in Management - June 1990

Advisor: P. M. Carrick - Department of Administrative Science

The primary objective of this thesis is to perform a cost effectiveness analysis of the various purchasing methods available to Dudley Knox Library on the Naval Postgraduate School campus in Monterey, California. The intent of the study is to identify the most cost efficient method of procuring books within the guidelines of the Federal Acquisition Regulation (FAR). The research was conducted by reviewing current literature and interviewing persons acquainted with the various cost elements which occur when purchasing books at the Naval Postgraduate School. Approval Plans were found to be the least costly way for a Department of Defense library to purchase books if the library was large enough to sustain an approval plan.

**MANDATORY PARTICIPATION IN THE DIRECT DEPOSIT
SYSTEM FOR U.S. NAVY MEMBERS: ISSUES AND CONCERNS**

Molly J. McClellan - Lieutenant, United States Navy

B.A., University of Minnesota, 1975

B.S.B., University of Minnesota, 1980

Master of Science in Management - June 1990

Advisor: K. J. Euske - Department of Administrative Science

This thesis discusses issues pertaining to the implementation of a mandatory direct deposit policy by the U.S. Navy. Research was concentrated on issues of concern to the afloat community and personal financial management. Availability of cash underway, the impact of shipboard ATM's and the ability of the Navy's various afloat pay data entry systems to provide accurate and timely service in a direct deposit environment were analyzed. The personal financial management skills necessary for successful interaction with the Direct Deposit System were defined and the Navy's current means of providing training to acquire those skills were explored. Among the conclusions reached by the author are that the Navy's current afloat pay data entry systems cannot provide sufficiently timely or accurate service to support a mandatory direct deposit policy, and that the Navy's current means of providing relevant personal financial management skills training are inadequate to prepare Navy members for mandatory direct deposit policy.

**USE OF AVIATION 3-M INFORMATION OUTPUTS BY ORGANIZATIONAL
MAINTENANCE USERS**

**David Alexander McCutcheon, III - Lieutenant, United
States Navy Reserve**

B.S., Middle Tennessee State University, 1980

Master of Science in Management - December 1989

Advisor: W. J. Haga - Department of Administrative Science

This thesis presents the results of a study concerning the use of information outputs from the Aviation 3-M System by organizational level maintenance users. Specifically examined are Naval Aviation Maintenance Support Office (NAMSO) information reports, Naval Aviation Logistics Data Analysis (NALDA) information outputs, and squadron-generated monthly 3-M summaries. A survey using unstructured interviews with squadron data analysts and maintenance managers was conducted to investigate how the information outputs are meeting users' needs and in what capacity. A review of the Aviation 3-M System, the information products derived the results of the survey are provided. It is shown that such outputs have limited impact on decision making in organizational level maintenance due to the time lag of 3-M data.

AN INITIAL ANALYSIS OF THE NAVY'S SEA COLLEGE PROGRAM

Thomas M. McManus - Lieutenant Commander, United States Navy

B.S., Marine Maritime Academy, 1979

Master of Science in Management - December 1990

Advisors: S. L. Mehay & M. J. Eitelberg - Department of Administrative Science

This thesis is an initial examination of the Navy's Sea College Program (SCP) that was offered as an enlistment incentive in fiscal 1987. The research attempts to determine if the SCP had a positive influence on the number or "quality" of enlistments into the Navy's general detail (GENDET) personnel ratings by examining the records of recruits from fiscal 1983 to 1989. Levels of recruit "quality" were measured during the time the SCP was offered using mean percentile scores on the Armed Forces Qualification Test (AFQT) and scores on SCREEN, a method for estimating an individual's potential for successful service. A literature review was also undertaken to identify existing information on the value of an educational benefit plan as an enlistment incentive. The results of the research show that enlistments into GENDET ratings increased with the SCP was offered, especially for the Fireman rating. In addition, the results reveal that the level of recruit quality significantly improved in the Seaman and Airman ratings. It appears that the SCP was moderately successful in helping the Navy to recruit high-quality youths for assignment to GENDET occupations. Further research on the SCP is recommended.

**A PROPOSED GUIDE FOR IMPROVING THE ORGANIZATION AND CONDUCT
OF PROCUREMENT MANAGEMENT REVIEW WITHIN THE MARINE CORPS
FIELD CONTRACTING SYSTEM**

Brian L. McMillan - Captain, United States Marine Corps

B.A., Southern Connecticut State College, 1978

Master of Science in Management - March 1990

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

This thesis analyzes the organization and conduct of the Procurement Management Review (PMR) program within the Marine Corps Field Contracting System. An attempt is made to identify, to the maximum extent possible, the goals, management philosophy, organization, and methods considered to be ideal for PMR by three sources: Literature, previous studies, and contracting professionals. An analysis and comparison between this consensus and HQMC's current PMR policies and procedures, as well as field contracting personnel's perceptions of these policies and procedures is conducted to highlight similarities and differences, and to provide acquisition managers at HQMC with alternatives for improving current practices to optimize the effectiveness of the PMR program, given the Marine Corps Field Contracting System's peculiar acquisition needs and structure.

MARINE CORPS FINANCIAL MANAGEMENT OFFICER TRAINING IN THE 1990'S

Judith J. Mellon - Captain, United States Marine Corps

B.S., University of New Mexico

Master of Science in Management - June 1990

Advisor: R. Evered - Department of Administrative Science

This thesis evaluates the adequacy of the current training programs provided to Marine Corps financial officers with the primary Military Occupational Specialty (MOS) 3404. Using the responses from a financial training questionnaire which was distributed to Marine financial officers, and interviews with selected senior financial officers. The thesis explores how training programs can be enhanced to best prepare these officers for the 1990's. This research concluded that: (1) Financial officers will need to be versatile to deal with the changing financial systems in the 1990's; (2) The Financial Management Officers Course can be improved by adding a supervisory perspective of disbursing and exposure to the other financial management areas; (3) The Marine Corps Practical Comptrollership Course should be targeted at officers with approximately three years experience and an advanced course should be developed; (4) More intra-MOS training should be encouraged.

ANALYSIS OF DISPUTES RELATIVE TO GOVERNMENT FURNISHED PROPERTY

Walter Harold Melton - Lieutenant, United States Navy

B.B.A., East Tennessee State University, 1979

Master of Science in Management - June 1990

Advisor: R. W. Smith - Department of Administrative Science

The purpose of this thesis is to identify problems in the management of Government Furnished Property (GFP) in the Government's acquisition process. The research focused on the reasons the Armed Services Board of Appeals (ASBCA) sustained the contractor's appeal of the contracting officer's final decision (COFD). Using this research methodology, it was found that the rationale used by the ASBCA in sustaining the contractor's appeal could be used to categorize the problems in the management of GFP as follows: (1) GFP not suitable for its intended use, (2) Government failure to deliver GFP, (3) Government failure to compensate for additional costs associated with additional items of GFE, (4) equipment should have been GFE vice CFE, and (5) Government failure to maintain accurate records of what it furnished as GFP. Reasons one and two are related to the Government's requirements under the GFP clause and account for 72.7% of the ASBCA's reasons for sustaining the appeals of this study. The study also showed that case law is the most highly relied upon basis to support the ASBCA's decision, followed by the GFP clause.

THE BRAZILIAN AEROSPACE INDUSTRY: A CASE STUDY OF THE TECHNOLOGICAL IMPACT OF OFFSET AGREEMENTS IN A RECIPIENT COUNTRY

Julio Eduardo da Silva Menezes - Lieutenant, Brazilian Air Force

Master of Science in Management - December 1989

Advisor: E. J. Laurance - Department of National Security Affairs

This thesis examines the role of technology in determining the technological independence, national security enhancement, and economic benefits which occur as a result of military offset agreements in recipient countries. The study defines trade offsets and interprets the Brazilian government's offset and technology transfer policies. Using cases from the Brazilian aerospace industry, the researcher performed an analysis of four types of offsets (countertrade, technology transfer, licensed production, and coproduction) to test the hypothesis that technology is the driving factor in the design of offset requirements for recipient countries. The thesis concludes with some recommendations to improve the Brazilian government's offset policy and decision-making process.

A PROCUREMENT POLICY MANUAL FOR THE NAVY FIELD CONTRACTING SYSTEM (NFCS)

Samual B. Moyle, III - Lieutenant, Supply Corps, United States Navy

B.S., University of South Carolina, 1976

Master of Science in Management - September 1990

Advisor: D. V. Lamm - Department of Administrative Science

This research effort explores the merit of developing a procurement policy manual for purchasing organizations within the Navy Field contracting System (NFCS). The structure, content, uses, advantages, and methods for evaluating effectiveness found in the literature, as well as the generic characteristics of a procurement policy manual, are identified and discussed. These properties are then applied to Navy purchasing contracting activities and the differences and similarities analyzed. The research concluded that procurement policy manuals are useful and Navy contracting organizations should be encouraged to develop and use them. Many Navy manuals are not well organized and are often too technical. The generic characteristics of desirable manuals should be incorporated into the planning stage of manual development. Recommendations include encouraging the use of the manuals, applying the generic characteristics, training the procurement policy specialists, measuring manual effectiveness, making the manuals a part of procurement training, and using the manuals to evaluate purchasing performance. Ideas for related research efforts complete this thesis.

PERSONAL COMPUTER USE AT NAVY FIELD ACTIVITIES:

A PRODUCTIVITY STUDY

Robert P. Murphy - Lieutenant, Supply Corps, United States Navy

B.A., University of Notre Dame, 1980

Master of Science in Management - December 1989

and

Lorraine S. Davis - Lieutenant, United States Navy

B.S., Pennsylvania State University, 1982

Master of Science in Management - March 1990

Advisor: W. J. Haga - Department of Administrative Science

In the past, corporations justified investment in office automation (OA) by vague claims of increased productivity. Now, managers are reevaluating their productivity measurement systems in an effort to identify productivity gains resulting from OA. The purpose of this thesis is to present a methodology for determining the impact of OA on office productivity. This study examined the productivity of the Standard Automated Contracting System for Federal Agencies (SACONS), in a before/after quasi-experimental design that measured outputs (volume, quality of work), inputs (staff size, grade structure, overtime usage), and by-product social effects (morale, teamwork) using archival data. This framework, developed in a previous SACONS study, is used to analyze the strength of SACONS software. The results of this study were confounded by external events that adversely affected our results. Only the quality of work measure (Procurement Action Lead Time), which was reduced by 13 percent, showed a significant productivity gain. Further study of SACONS is necessary to determine its impact on office productivity.

ALLOWANCE TYPE CODE SEVEN MATERIAL: AN ANALYSIS OF THE CURRENT DISPOSAL SYSTEM

James P. Naber - Lieutenant, Supply Corps, United States Navy

B.A., Swarthmore College, 1979

Master of Science in Management - December 1989

Co-Advisors: T. P. Moore & T. H. Holvik - Department of Operations Research

The purpose of this thesis is to evaluate the current system for the disposal of Allowance Type (AT) Code 7 material from submarine tenders, focusing specifically on material with an extended cost less than \$20. The current disposal system will be analyzed and improvements recommended. Alternative disposal systems will also be identified for possible consideration. Although this thesis addresses only submarine tenders that have relatively large amounts of AT Code 7 material, the conclusions should be applicable to the low value excess material on other ships.

ANALYSIS OF THE UNIFORM BUILDING CODE
Karen F. M. Natsuhara - Lieutenant, United States Navy, Reserve,
Civil Engineer Corps
B.S., University of Hawaii, Manoa, 1980

and
Roger M. Natsuhara - Lieutenant, United States Navy, Civil Engineer Corps
B.S., University of California, Berkeley, 1980
Master of Science in Management - December 1989
Advisor: P. M. Carrick - Department of Administrative Science

This thesis examined and analyzed the International Conference of Building Officials (ICBO) who produces a public good, the Uniform Building Code. The Uniform Building Code is one of the three "model building codes" produced in the United States for use and adoption as a baseline building code for states and local municipalities. The process by which ICBO produces the Uniform Building Code was first examined and then several users of the code were examined to determine if ICBO produces this model codes in sufficient quantity. The users examined were all from the State of California. Based on the analysis of this thesis, it was determined that ICBO does produce the Uniform Building Code in sufficient quantity to its users. Also included is an examination of the Naval Facilities Engineering Command (NAVFACENGCOM) and how it regulates design and construction for Navy projects. Recommendations include studying whether the NAVFACENGCOM should adopt the "model building codes" as a baseline for the "Navy's Building Code."

**A COMPARISON OF TRAINING EFFECTIVENESS OF FORMAL AND ON-THE-JOB
ENLISTED RATE TRAINING IN THE UNITED STATES COAST GUARD**

Robert Michael O'Brien - Lieutenant, United States Coast Guard
B.S., University of Central Arkansas, 1977
Master of Science in Management - December 1989
Advisor: B. Roberts - Department of Administrative Science

This study compares the effectiveness of on-the-job and formal training methodologies of United States Coast Guard enlisted rate training as a function of job performance and rate of advancement. Results indicate there is no significant difference in evaluated work performance between "A" school and striker graduates at the E4 and E5 rank. The comparison of rate of advancement of E5 indicates the Boatswains Mate (BM) and Machinery Technician (MK) personnel undergoing the striker, on-the-job training advance significantly faster than their "A" school counterparts. The difference in rate of advancement between Yeoman (YN) and Storekeeper (SK) strikers and "A" school graduates was not found to be statistically significant. Recommendations are made to perform a cost effectiveness study, review selection criteria for "A" schools and establish striker program standards.

RELATIONSHIP AND PERCEPTION BETWEEN KOREA AND THE U.S.

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B.A., Korea Military Academy, 1983
Master of Science in Management - June 1990
Advisor: R. A. McGonigal - Department of Administrative Science

During the last century, Korea and the United States have maintained a cordial and friendly relationship. Normally, Korea is considered to be a pro-American country in international society and that has been true. However in recent years, it has not always been the case considering the recent phenomena happening in Korean society. How can it happen that Korea cannot be pro-American given the Korea normally had been dependent on the United States? In this paper, the reality of the Korean's perception is analyzed by focusing on the historical facts that have affected Koreans' perceptions throughout their relationships between the United States and Korea. Also, the recent causes of negative perceptions of America are examined.

A TAXONOMIC APPROACH TO CONTRACTING OFFICER TASKING

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B.A., Virginia Military Institute

Master of Science in Management - December 1989

Advisor: D. V. Lamm - Department of Administrative Science

The title Contracting Officer carries with it many significant responsibilities. Many of the contracting officer's tasks are mandated by the Federal Acquisition Regulation, while others are optional given the circumstances at hand. This study of Taxonomy through the application of a modified version of the Berliner, Angell, and Shearer behavioral classification scheme to the Federal Acquisition Regulation (FAR). An objective approach was adopted for the classification of contracting officer tasks, both implicitly and explicitly presented in the text of the FAR. The researcher quantified the study's findings, analyzed noted data trends, and discussed their implications. Certain unique characteristics of the classification scheme often resulted in the unavoidable application of individual judgement when applying the taxonomy to the FAR. The researcher concluded that given the relative consistency of the study's findings with previous research work, the benefits associated with the application of a taxonomy far outweigh this shortcoming.

A STUDY OF THE EFFECT PERFORMANCE APPRAISALS HAVE ON MOTIVATING IMPROVED PERFORMANCE AND PRODUCTIVITY FOR GS-1105 SERIES CONTRACTING PERSONNEL AT U.S. NAVY SMALL PURCHASE ACTIVITIES

Howard Malone Patty - Lieutenant Commander, Supply Corps, U.S. Navy

B.B.A., Texas A & M University, 1978

Master of Science in Management - December 1989

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

The purpose of this thesis is to study the effect performance appraisals have on motivating improved performance and productivity for GS-1105 series contracting personnel at U.S. Navy Small Purchase Activities and to evaluate the compatibility of the current performance appraisal system with the applicable performance appraisal concepts of Total Quality Management (TQM). A questionnaire was developed and distributed to various Navy small purchase activities which was used to determine perceptions that these contracting personnel have about their performance appraisals. Additionally, several examples of these activities' performance appraisal standards were analyzed for compatibility with the Total Quality Management performance appraisal concept. It was determined that performance appraisals do have an effect on motivating increased performance and productivity and that current performance appraisal standards are not compatible with TQM.

AFQT SCORE FORECASTING MODELS FOR REGIONAL ESTIMATION OF QUALIFIED MILITARY AVAILABLE

Jeffrey M. Peterson - Captain, United States Marine Corps

B.S., University of Wisconsin-Platteville, 1982

Master of Science in Management - June 1990

Advisor: G. W. Thomas - Department of Administrative Science

Estimation of regional distributions of the qualified military available (QMA) population is essential for determining an efficient allocation of recruiting resources. Estimates of regional mental ability distribution are required in order to estimate QMA. Using data from the Youth National Longitudinal Survey (NLSY), logit regression equations are used to estimate the probability that a 17 to 21 year old high school graduate will score above the 50th percentile on the Armed Forces Qualification Test (AFQT). This probability is modeled as a function of sociodemographic variables including gender, race/ethnicity, parents' education, poverty status, income, residence in an urban area and receipt of welfare payments. Best fit equations are developed in order to facilitate calculation of nationwide county-level AFQT distributions.

**END-USER COMPUTING DEVELOPMENT STRATEGY FOR THE ARMED FORCES OF
THE REPUBLIC OF INDONESIA IN THE 90'S**

**Paulus Prananto - Lieutenant Colonel, Indonesian Army
B.S., National Military Academy, 1970**

Master of Science in Management and Information Systems - June 1990

Advisor: T. Bui - Department of Administrative Science

The policy on the development of defense and security for The Armed Forces of the Republic of Indonesia (ABRI) envisages the creation of a viable deterrent power through the effective use of all the components of ABRI as a relatively small but effective and efficient nucleus sustained by real national capabilities. It is therefore driving ABRI to realize better use of its resources. A pivotal factor in this goal is the investment in the information technology of the future, today. Within the information architecture, the growing phenomenon of End-User Computing (EUC) is recognized as a valid technological base for providing end-user support. The idea behind the EUC concept is to help encourage end-users produce information system applications more rapidly, more responsively, and more cost-effectively than if these applications were developed by the Data Processing Center. However, EUC also introduces new organizational, managerial, and technical risks by propagating resources that are not easily controlled by traditional means. The purpose of this thesis is to examine the alternatives available to ABRI for developing EUC to match the organizational's goals, objectives, and strategies.

EVALUATION OF AIRCRAFT TURBINE REDESIGNS

**Larry D. Price - Lieutenant Commander, United States Navy
B.S., United States Naval Academy**

and

**Eugene G. Sudol, Jr. - Commander, United States Navy
B.S., University of New Mexico**

Master of Science in Management - June 1990

Advisor: P. M. Carrick - Department of Administrative Science

This thesis is a study of the Aircraft Turbine Engine Component Improvement Program (CIP). The study examines some of the problems associated with determining benefits accrued from CIP. The major thrust of the thesis was developing a component selection methodology and an analysis procedure for detecting changes in logistics parameters. The data source was the Engine Component Information Feedback Report (ECIFR). Data for this report come from aviation organizational level maintenance activities and squadrons. The thesis reached the conclusion that the effects of CIP are more effectively assessed at the component level rather than at the system level. The thesis further demonstrated the logical and data collection difficulties encountered in the process of isolating the incremental benefits obtained from CIP expenditures.

**A CASE STUDY OF THE LIGHT ARMORED VEHICLE-25: INTEGRATED
LOGISTICS SUPPORT OF A NON-DEVELOPMENTAL ITEM**

Francis A. Quindlen, Jr. - Major, United States Marine Corps

B.A., Villanova University, 1975

M.A., Pepperdine University, 1981

Master of Science in Management - December 1989

Advisor: A. W. McMasters - Department of Administrative Science

In today's era of budgetary constraints, the military Services are being pressured to procure non-developmental or "off-the-shelf" equipment for use. This thesis is a case study of a non-developmental system, the Marine Corps' Light Armored Vehicle-25 (LAV-25). The decision to quickly acquire this non-developmental system was motivated by the urgent need for the Marine Corps to have a vehicle of this type to support their mission as a rapid deployment force. Combining a non-developmental system and an accelerated acquisition strategy produced a near-term logistics support. This thesis identifies the inability to competitively reprocur spares and repair parts and the lack of a post production support plan as the two most serious problems in the fielding of the LAV-25. The lessons learned are that competitive spares reprourement and post production support must be comprehensively planned for prior to award of a non-developmental production contract.

**AN ANALYSIS OF DIRECT VENDOR SHIPPING OF MEDICAL MATERIAL TO
OVERSEAS NAVAL MEDICAL MATERIAL**

**Gary Howard Rakes - Lieutenant, Medical Service Corps, U.S. Navy
B.S., Lynchburg College, 1983**

Master of Science in Management - December 1989

Advisor: T. P. Moore - Department of Administrative Science

The purpose of this thesis is to review selected methods for transporting direct vendor medical material to overseas medical activities and to determine if a problem exists with respect to lost, late, or frustrated medical shipments. The shipping of direct vendor medical supplies is a major concern for medical material managers. Problems encountered in the transportation of this material can directly affect the mission of our overseas treatment facilities. This research describes selected methods of transporting direct vendor medical material and evaluates them for accuracy and timeliness. Based on this analysis, there appears to be a problem in the shipping of direct vendor medical supplies to Western Pacific area naval hospitals.

**FACTORS INFLUENCING THE RETENTION OF NONCOMMISSIONED AND STAFF
NONCOMMISSIONED OFFICERS IN THE SELECTED MARINE CORPS RESERVE**

**Jeffrey S. Randall - Captain, United States Marine Corps
B.S., Kansas State University, 1980**

Master of Science in Management - December 1989

Advisor: G. W. Thomas - Department of Administrative Science

This thesis examines factors which influence the retention of male noncommissioned officers (NCOs) and staff NCOs (grades E4 to E6 with four to twelve years of service) in the Selected Marine Corps Reserve. Data used combined the responses from the 1986 Reserve Components Survey and the member's current status from the Reserve Components Common Personnel Data System. Logit regression was used to measure the impact of various demographic, economic, perceptual and satisfaction variables on retention. Models were developed for four separate groups: prior service (PS) single, PS married, non prior service (NPS) single and NPS married members. The thesis identifies different behavior patterns among the four groups. Findings are as follows: NPS married retention was highly influenced by monetary variables; NPS single retention was influenced by both monetary and satisfaction variables; PS married retention was influenced by military occupation, tenure and family influences; PS single retention was influenced by tenure and retirement benefits.

**A STUDY AS TO THE FEASIBILITY OF THE DEPARTMENT OF DEFENSE
MANDATING ITS SUPPLIER BASE ADOPT TOTAL QUALITY MANAGEMENT**

**Donald J. Reiter - Lieutenant Commander, Supply Corps, U.S. Navy
B.A., Chapman College, 1979**

Master of Science in Management - December 1989

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

The purpose of this thesis is to study the issues surrounding whether DoD can successfully mandate its supplier base adopt Total Quality Management (TQM), or an equivalent quality-orientated management philosophy. Hewlett-Packard and Motorola, Inc., two firms currently requiring their suppliers adopt a quality-focused management philosophy, were studied. The researcher determined that DoD could successfully mandate its supplier base adopt TQM provided the following infrastructure was in place and well established prior to the mandate: adequate in-house experience and expertise; comprehensive supplier training program; supplier performance tracking capability; comprehensive supplier quality audit procedure; formal joint DoD-industry TQM council; and congressional support.

AN ANALYSIS OF UNASSIGNED DIRECT MATERIAL AT NAVAL SHIPYARDS

Mark D. Rohrbach - Lieutenant, United States Navy

B.S., United States Naval Academy, 1983

Master of Science in Management - December 1989

**Co-Advisors: A. W. McMasters & G. Eberling - Department of
Administrative Science**

Unassigned Direct Material (UDM) accounts at naval shipyards, which consist of surplus material from the overhaul process, continue to grow at a rapid pace (42% per year since 1985). Minimal return on material placed in these accounts coupled with a shrinking defense budget has forced the navy to take a closer look at inventory methods at naval shipyards. The author, in an effort to propose potential solutions to the growing UDM account problem reviewed the current policies and procedures governing inventory control/inventory management at naval shipyards. Extensive interviews were conducted with personnel at NAVSEA, SPCC, and all eight naval shipyards with emphasis at Mare Island Naval Shipyard. The current policy outlined by NAVSEA needs to be better implemented. This coupled with a two-pronged effort aimed at creating a historical usage database to better identify material requirements and increasing the visibility of UDM should assist in reducing the amount of this surplus material.

VALIDATION OF THE NAVY RECRUITER SELECTION TEST BATTERY

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B.S., University of Colorado, 1985

Master of Science in Management - December 1989

Advisor: S. L. Mehay - Department of Administrative Science

The purpose of this thesis is to validate the Navy Recruiter Selection Test Battery (RSTB) as a predictor of recruiter success. A sample of recruiters who took the test battery in 1982 was studied with respect to productivity on recruiting duty in subsequent years. The measure used to determine success on recruiting duty was average yearly production rates. Various statistical techniques, including cross tabulations, correlation analysis, and multivariate regression analysis, were used to determine the relationship between RSTB scores and recruiter success. The outcome of this research suggests that, overall, the RSTB is not able to predict recruiter success with a high degree of accuracy. Biodemographic characteristics of the recruiters were also examined to determine if they could be used, in conjunction with the RSTB, to predict success. The analysis suggests that the occupational specialty of Navy Counselor could be useful in screening for potential successful recruiters.

THE VP READINESS SYSTEM: CORRELATING RESOURCES TO PERFORMANCE

Michael John Sakraida - Commander, United States Naval Reserve

B.S., Southern Oregon College, 1971

and

James DeBell Heffernan - Lieutenant, United States Navy

B.S., United States Naval Academy, 1981

Master of Science in Management - June 1990

Advisor: J. M. Fremgen - Department of Administrative Science

The current fiscal environment, with its budgetary uncertainty, forces the Department of Defense to ensure it is receiving the maximum readiness for each dollar spent. This thesis presents an analysis of the current VP readiness system as a method for efficient and effective allocation of resources. It traces the funding for VP squadrons and discusses the training background of individual crews and their specific crew members. It describes the entire military readiness system and how the VP readiness system, as it is used today, relates to this system. The thesis develops a model to illustrate the relationships between resource usage and readiness within the VP community. Several approaches to validate the current VP readiness system were made using this model. However, only limited significant relationships were found. Numerous recommendations to improve the current VP readiness system are made based on the results obtained in testing the model.

LEADERSHIP STYLES IN UNITED STATES MARINE CORPS TRANSPORT HELICOPTER SQUADRONS

David Jerome Salter

Master of Science in Management - December 1989

Co-Advisor: A. M. Crawford - Department of Administrative Science

This thesis examined leadership styles in United States Marine Corps transport helicopter squadrons. Analyses were conducted to determine how leadership styles related to subordinate extra effort, leader effectiveness, satisfaction with leader, unit cohesion, and unit morale. The importance of military history to the development of military leaders was also examined. Leadership styles of officers were evaluated by the leader himself as well as his subordinates, superiors, and peers. Proactive transactional leadership styles were found to be the most commonly used styles, while reactive and nonleadership were found to be the least used styles. Transformational styles had a strong relationship to subordinate extra effort, leader effectiveness, and unit cohesion and morale. Differences in how a leader perceived himself as compared to how others perceived his style were also related to effective leadership.

NAVAL POSTGRADUATE SCHOOL COST CENTER FINANCIAL MANAGEMENT GUIDE

Mike W. Sanders - Major, United States Marine Corps

M.A., Webster University, 1989

and

David G. Mascarin - Lieutenant, United States Navy

B.S., Glasgow College of Nautical Studies, 1978

Master of Science in Management - December 1989

Advisor: G. Eberling - Department of Administrative Science

The purpose of this thesis is to identify the functions and responsibilities of the Naval Postgraduate School personnel who routinely manages operating and research funds; and to develop a comprehensive, entry level financial management guide to assist cost center personnel in effectively managing these financial resources. The management guide provides an introductory background to the key financial concepts and terms associated with the Navy's Resource Management System (RMS), followed by a description of the procedures necessary to prepare the financial documents commonly used at the Naval Postgraduate School. The guide then depicts the basic flow of the School's financial documents, and concludes with recommended procedures for preparing, maintaining and reconciling sub-cost center accounting records. The guide is primarily intended for use in the cost and sub-cost centers of the Naval Postgraduate School, Monterey, California.

NATIONWIDE MOBILE COMMUNICATION SYSTEMS

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B.S., San Jose State University, 1978

Master of Science in Management - June 1990

Advisor: B. C. Boger - Department of Administrative Science

This thesis provides a basic understanding of nationwide terrestrial and satellite mobile communications and tracking technologies. Covered are systems currently available and in development. An analysis of user costs is performed for comparison. A more detailed mobile satellite cost/benefit analysis for use by the trucking industry is also presented. Follow-on chapters contain discussions of the basic economic issues faced by satellite system operators and the regulatory history of mobile satellite services. Contained in the appendices are a more detailed discussion of mobile satellite systems and a layman's explanation of communication and navigation technologies. The conclusion presents comments on the possible future direction of these new mobile communication services and makes recommendations for trucking industry use.

AN ANALYSIS OF NAVY RECRUITING COMMAND'S OFFICER GOALING MODELS

Robert R. Senter, Jr. - Lieutenant Commander, United States Navy

B.A., Tulane University, 1978

Master of Science in Management - June 1990

Advisor: S. L. Mehay - Department of Administrative Science

This study examines the goaling models used by the Navy Recruiting Command for the Nurse Corps and Nuclear Propulsion Officer Candidate (NUPOC) programs. These two programs serve as representative samples for the numerous officer recruitment programs administered by the Navy Recruiting Command. The intent of the study is to analyze and validate the accuracy of the current goaling models, to ascertain factors which could improve the accuracy of the models, and to make recommendations for improving the models. The thrust of the study is to analyze and devise methods to make the allocation of recruiting goals as fair and as efficient as possible. This study also recommends areas for future research that may lead to further improvements in assigning officer recruiting goals.

PROCEDURES FOR ACQUISITION OF MAJOR SYSTEMS FOR THE PAKISTAN NAVY

Waqar Siddiq - Lieutenant Commander, Pakistan Navy

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Master of Science in Management - December 1989

Advisor: R. W. Smith - Department of Administrative Science

This thesis describes and evaluates the process of major systems acquisition in the United States and the Pakistan Navy. It describes the process of initiation of the needs to the deployment of the system. The differences between the systems of the two countries are highlighted and based upon this comparative evaluation a model for the acquisition of major systems for the Pakistan Navy has been developed.

WHAT YOU ALWAYS WANTED TO KNOW ABOUT MONITORING SHIP CONSTRUCTION BUT YOU DID NOT DARE ASK

George Sideris - Lieutenant Commander, Hellenic Navy

B.S., Hellenic Naval Academy, 1975

B.S., The Piraeus Graduate School for Industrial Studies, 1986

Master of Science in Management - June 1990

Advisor: D. Trietsch - Department of Administrative Science

Control of a Naval Construction project, is a significant and difficult problem; Project complexity, and contract type, military urgency, and contractor identity affect the degree and type of control necessary. This thesis study discusses a summary of essential guidance for performance of functions; the interdependency of cost, quality, time, and performance; and a survey of techniques and methods for managing each of these parameters. A naval construction project can be one of the most difficult problems to manage and evaluate. This is largely due to the difficulty of measuring performance and its interaction with cost, quality, and time. In managing the performance, the results will vary according to the different forms, such as contract administration, formal views, financial and engineering reports, quality assurance and various status indexes.

**THE INFLUENCE OF CONTRACT TYPE IN PROGRAM EXECUTION/V-22
OSPREY A CASE STUDY**

**Danny Roy Smith - Lieutenant, Supply Corps, U.S. Navy
B.B.A., University of Kentucky, 1976
Master of Science in Management - December 1989
Advisor: M. McCaffrey - Department of Administrative Science**

The purpose of this study was to look at the impact of a fixed price type contract on program execution of a major weapon system. The full scale development phase of the V-22 Osprey program was used as a case study. The focus of this thesis was to determine the affects of this contract type and identify the actions program management took to address it's influences. The predominant conclusion brought out by this research was that based on the political, historical, and economic circumstances of the period, the fixed price type contract was the best contractual instrument for the government to use. The major recommendations are: in future contracts, 1) Ensure an appropriate spread between ceiling and target price in order to adequately incentivize the contractor; 2) In teaming arrangements, employ incentives to guarantee the appropriate transfer of technical information; 3) Incentivize comprehensive production plans and Production Readiness Reviews.

AN ANALYSIS OF THE PROPOSED AIRLINE COMPETITION ENHANCEMENT ACT

**Janice S. Smith - Lieutenant Commander, United States Navy
B.A., University of Maryland, 1975
Master of Science in Management - June 1990
Advisor: D. C. Boger - Department of Administrative Science**

This analysis examines problem issues in the passenger airline industry and determines how the proposed Airline Competition Enhancement Act would impact these issues. A summarization of the history of airline deregulation is followed by an assessment of the factors that are contributing to the call for re-regulation. From this assessment, recommendations for changes to the proposed Airline Competition Enhancement Act are made.

SUPPLY-SIDE ECONOMICS IN THE REPUBLIC OF KOREA

**Hyung Chan Son - Captain, Republic of Korea Army
B.S., Korea Military Academy, 1984
Master of Science in Management - June 1990
Advisor: D. R. Henderson - Department of Administrative Science**

This thesis investigates in detail the effects of "Reaganomics" South Korean style. The study describes Korea's tax system and attempts to measure the effect of changes of the Korean tax rate on total tax revenues. The main findings are as follows: (1) Lowering marginal tax rates contributed to income growth and increased tax revenues for people with income above ten million won in 1985 won. This evidence suggests that this group of Korean taxpayers was in the prohibitive region of the Laffer curve. (2) However, with the first installment of the tax cut in 1982, tax revenues fell with the fall in tax rate for taxpayers with incomes above 65 million won. This result makes sense because the taxpayers knew the 1984 tax cut was coming. Income could have been deferred from 1982 and 1983 into 1984 by taxpayers having the flexibility to do so. Conversely, the reduction in tax rate in 1984 caused a rise in tax revenue for this high-income group. This evidence is also strikingly suggestive that these highest-income Korean taxpayers were previously in the prohibitive region of the Laffer curve.

A PROPOSED RTN OFFICER PERFORMANCE EVALUATION SYSTEM

Werapan Sookgont - Lieutenant, Royal Thai Navy

B.S., Royal Thai Naval Academy, 1979

Master of Science in Management - December 1989

Advisor: R. A. McGonigal - Department of Administrative Science

This study seeks to formulate a recommendation for the improvement of the Royal Thai Navy Officer Performance Evaluation System. The research methodology includes the following three components: (1) a study of pertinent performance evaluation literature, (2) a study of U.S. military evaluation systems, and (3) an analysis of the questionnaire survey regarding the present Royal Thai Navy Officer Performance Evaluation System. After assimilating and categorizing relevant information, it is concluded that the Royal Thai Navy Officer Performance Evaluation System must be modified to more accurately and effectively document officer performance. Specific recommendations are offered to bring about the necessary changes. These include a proposed RTN Officer Performance Evaluation form and a feedback to the evaluated officer. Finally, based on the research results, an alternative for modifying the evaluation format is suggested to increase the efficiency and effectiveness of the current system. It is hoped that this study will set forth ideas to improve the performance evaluation of Royal Thai naval officers in the future.

ARMED FORCES AND NATIONAL DEVELOPMENT, IN THE CASE OF REPUBLIC OF INDONESIA

Sukirno - Commander, Indonesian Navy

B.S., University of Indonesia

Master of Science in Management - March 1990

Advisor: R. A. McGonigal - Department of Administrative Science

As a modern organization, the military becomes aware of the need for transition and it often becomes an agent of change for society. In the context of national development the military represents a major institution in the country of Indonesia. Its enormous size has made it the most powerful and well-organized group within Indonesian society, imparting modern values to the still traditional milieu. Thus, the Indonesian Armed Forces have a double function of playing a central role of contributing to the nations' development, first, as a defense and security force and secondly, as a socio-political force. The Indonesian Armed Forces as a modern institution has significantly contributed to the development of the Republic of Indonesia. This thesis will contribute toward a better understanding of the role of the armed forces and their contribution to national development.

THE DEFENSE PRIORITIES AND ALLOCATION SYSTEM IN AN INDUSTRIAL MOBILIZATION

Robert Dismas Sutter - Lieutenant Commander, Supply Corps,

United States Navy

B.S., United States Naval Academy, 1977

Master of Science in Management - December 1989

Advisor: P. M. Carrick - Department of Administrative Science

Successful industrial mobilization is recognized as fundamental to the success of a military mobilization. The U.S.'s present system for allocation of raw materials and component parts is the Defense Priorities and Allocation System (DPAS). DPAS represents a major mechanism for industrial mobilization. Its success or failure to meet mobilization requirements is an excellent gauge for overall industry-military performance in a mobilization. Through a review of current regulation and procedures, a study of past industrial mobilizations in wartime and of recent mobilization exercises, this study demonstrates that DPAS can adequately allocate limited resources during mobilization if the critical materials requirements are updated and if thorough and pre-legislated planning is enacted.

A CLASSIFICATION AND ANALYSIS OF CONTRACTING LITERATURE

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B.S., University of Pennsylvania

Master of Science in Management - December 1989

Advisor: D. V. Lamm - Department of Administrative Science

This thesis was an attempt to classify and summarize literature in the acquisition and contracting field. The primary objective of this thesis was to develop a taxonomy for categorizing literature published in the contracting field. Other than simple author, title, or subject classification schemes, no such taxonomy previously existed. A secondary objective of this thesis was to evaluate the effectiveness of the taxonomy, to determine how well it met the requirements of the defined optimal classification scheme. Another objective of this thesis was to apply the taxonomy to a finite body of existing contracting literature. This exercise demonstrated that the taxonomy could be practically applied and the results demonstrated its usefulness. The final objective of this thesis was to evaluate the information provided from application of the taxonomy to contracting literature. Since the scope of literature to which the taxonomy as applied was limited, the results were necessarily qualified. However, at the least, this application provided areas for further research.

AN ANALYSIS OF THE FACTORS AFFECTING MARINE CORPS OFFICER RETENTION

Robert J. Theilmann - Captain, United States Marine Corps

B.S., Villanova University, 1977

Master of Science in Management - September 1990

Advisor: G. W. Thomas - Department of Administrative Science

This thesis examines factors which influence the retention of male, company-grade Marine Corps officer (grades 0-1 to 0-3) who are within their initial period of obligated service. Data used combined responses from the 1985 DOD Survey of Officer and Enlisted Personnel and the respondent's 1989 status from the officer master file maintained by the Defense Manpower Data Center (DMDC). Logit regression was used to measure the relative importance of a broad range of factors for retention. These included: biographic and demographic characteristics, tenure data, perception of external job opportunities, and satisfaction with various aspects of military life. Results indicate that the individual's marital/dependant status, commissioning source, military occupational specialty, race, and satisfaction with specific intrinsic and extrinsic aspects of the military job are most important in predicting the retention behavior of junior Marine Corps officers with no less than 12 months of service and no more than seven and one-half years of active service. These findings can provide manpower planners with information to project and manage future retention levels of company-grade officers and to identify possible shortfalls in critical occupational specialties.

A STUDY OF THE IMPLEMENTATION AND ADMINISTRATION OF WARRANTIES BY MARINE CORPS ACTIVITIES

Keith B. Thompson - Captain, United States Marine Corps

B.S., West Chester State University, 1980

Master of Science in Management - December 1989

Advisor: M. J. McCaffrey - Department of Administrative Science

The purpose of this research was to analyze the problems and issues that users, specifically at the Intermediate Maintenance Activity (IMA) level, have properly implementing, administering and managing warranties for major weapon systems. The conclusions of the research are as follows: 1) the warranty is not always implemented to correct deficiencies; 2) there is a lack of training and knowledge of users in the field to the overall application and benefits of warranties; 3) the start of a warranty's duration should begin at the time the using unit places the item of equipment in use in order to reduce the amount of warranty time that expires before it is in an actual operational environment.

**A LOGIC MODEL TO REVIEW MATERIAL NOMINATED FOR INCLUSION INTO
PROJECT CODE PL3**

**Stephen J. Waite - Lieutenant Commander, Supply Corps, United States Navy
B.S., The Citadel, 1975**

and

**William J. Powers, Jr. - Lieutenant, United States Navy
B.S., State University of New York Maritime College, 1982
Master of Science in Management - December 1989**

Advisor: D. Trietsch - Department of Administrative Science

The Naval Petroleum Office (NAVPETOFF) has been assigned the responsibility of reviewing and managing the PL3 Prepositioned War Reserve Material Requirements (PWRMR) program. Limited guidance and direction has been provided to better manage and coordinate this task. The objective of this thesis was to clarify the existing guidance and use it to develop a rational and functional approach to this endeavor was the development of a decision review model. The model uses an item's criticality, shelf-life constraints, special handling requirements, substitutability, and present stock position as the key elements.

AN ANALYSIS OF THE REQUIREMENTS FOR A WINDSHEAR TRAINING PROGRAM

**Kevin Eugene White - Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1978**

Master of Science in Management - December 1989

Advisor: A. M. Crawford - Department of Administrative Science

The purpose of this thesis is to examine a deficiency in the Navy's P-3 flight crew training curriculum in the area of windshear and microburst survival and to analyze the requirements necessary for an effective training program. An analysis was conducted to identify training objectives, equate them to learning outcomes, and recommend media to support the training. The resulting media combination is presently available at each Fleet Replacement Squadron. Additional recommendations were made concerning training materials, costs and benefits, and windshear technology. Many of the procedures written in the P-3 NATOPS manual are the result of a major incident or the loss of lives. This thesis provides information necessary to implement a training program and procedures that could possibly save an aircraft and its crew.

**TRAINING SHORTCOMINGS IN THE DEPARTMENT
OF THE NAVY'S SMALL PURCHASE SYSTEM**

**Clark D. Willcox - Lieutenant, United States Navy
B.S., Southern Illinois University**

Master of Science in Management - June 1990

Advisor: D. V. Lamm - Department of Administrative Science

This thesis explores training weaknesses and requirements of civilian (GS-1105 series) mid-level personnel in the Naval Supply Systems Command (NAVSUP) small purchase arena. The purpose of the study is to identify the training inadequacies and to recommend alternative methods and forums to evaluate and correct training shortcomings. The thesis analyzes informal training plans and training methods of the Naval Supply Centers. In addition, formal small purchase mid-level GS-1105 training is examined. To establish a baseline for the research, the existing training documents in this area were evaluated to determine their currency, completeness, and effectiveness. The thesis proposes a revision and expansion to the Small Purchasing Professional Development: Training Course for Mid-Career Personnel as one means to fill training shortfalls.

**A COMPARATIVE ANALYSIS OF PUBLIC AND PRIVATE SECTOR
GRADUATE PROGRAMS IN PUBLIC POLICY**

David J. Wilson - Commander, United States Navy

B.S., United States Naval Academy, 1974

Master of Science in Management - December 1989

Advisor: N. C. Roberts - Department of Administrative Science

This thesis compares the top ten public administration/affairs and public policy programs in the United States and asks the question--is it feasible to offer a public administration/affairs or public policy curriculum at the Naval Postgraduate School? The results clearly show that most of the core courses and elective courses offered by the top ten programs are available at the Naval Postgraduate School. Additionally, because of a variety of factors which include an informed faculty on defense issues and defense organizations, courses available to the students, and access to leaders in the Department of Defense, a program in public administration/affairs or public policy is feasible at the Naval Postgraduate School.

AN ECONOMIC ANALYSIS OF MILITARY EXPENDITURES

Anthony Lee Winns - Lieutenant Commander, United States Navy

B.S., United States Naval Academy, 1978

Master of Science in Management - December 1989

Co-Advisors: W. R. Gates - Department of Administrative Science &

W. J. Walsh - Department of Operations Research

This thesis empirically explores the nature of the relationships between members of formal and informal alliances. A pooled time series cross sectional data methodology is employed to analyze those factors believed to have a significant impact on the behavior of national governments in allotting funds for defense. Regression analysis is performed on seventy-five countries over an eleven year period (1974-1984) including both NATO and non-NATO members; communist and non-communist nations; and developed and less-developed countries. The empirical results reveal inconclusive evidence for the traditional view that an inverse relationship exists between the military expenditures of allies. The distinction between formal and informal allies provides no further evidence of support and exposes some of the weaknesses of this view of military alliances.

**MASTER OF SCIENCE
IN
MECHANICAL
ENGINEERING**

**NUCLEATE POOL BOILING PERFORMANCE OF FINNED AND HIGH FLUX
TUBE BUNDLES IN R-114/OIL MIXTURES**

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Master of Science in Mechanical Engineering - December 1989

Advisor P. J. Marto - Department of Mechanical Engineering

The heat transfer characteristics of pure R-114 and R-114/oil mixtures during nucleate pool boiling from a small bundle of finned and High Flux tubes were measured. The bundles had 5 instrumented and 10 additional heated tubes of 15.8 mm outside diameter which were arranged in an equilateral triangular pitch of 19.1 mm giving a pitch-to-diameter ratio of 1.2. Pure refrigerant with York-C lubrication oil mass concentrations of 1, 2, 3, 6 and 10% was used. All experiments were performed at 2.2 C corresponding to a pressure slightly below atmospheric. Data sets were taken using decreasing heat flux only in order to avoid the boiling hysteresis phenomenon. An enhancement in heat-transfer performance of the finned tube bundle due to oil applications was observed. The enhancement increased with up to 3% oil concentration over all heat flux ranges. Further oil additions showed better performances than pure R-114 at high heat flux levels but poorer performance was obtained at lower heat fluxes. High Flux tube experiments indicated that the heat transfer performance of the bundle was approximately 2.5 times better than the finned tube bundle performance for pure R-114. No positive performance enhancement was observed from the High Flux tube bundle due to oil addition. The performance immediately degraded with 1% oil and stayed almost constant with 2% and 3% oil additions. A decrease of performance became significant at high heat flux levels with oil concentrations of 6% and 10%. The performance of these two tube bundles was compared to smooth tube operation.

**EFFECT OF ALUMINA PARTICLE ADDITIONS ON THE AGING
KINETICS OF 6061 ALUMINUM MATRIX COMPOSITES**

Susan Marie Allen - Lieutenant Commander, United States Navy

B.S., University of Rochester, 1979

Master of Science in Mechanical Engineering - June 1990

Advisor: I. Dutta - Department of Mechanical Engineering

Differential scanning calorimetry (DCS) was conducted using a monolithic 6061 aluminum material and two 6061 aluminum matrix composite materials. The composite materials were reinforced with 10 volume percent and 15 volume percent alumina particles. Electrical resistivity and hardness measurements during isothermal aging treatments were also conducted. The effects of prior aging and alumina particle additions on the growth kinetics and the thermal stability of the metastable phases in each material were studied. The results used to characterize the effect of reinforcement on the aging kinetics of composite materials.

3-DIMENSIONAL STRESS ANALYSIS OF SUPERHEATER HEADERS

Jonathan D. Barnes - Lieutenant Commander, United States Navy

B.S., United States Merchant Marine Academy, June 1979

Master of Science in Mechanical Engineering - December 1989

Advisor: G. Cantin - Department of Mechanical Engineering

Naval Sea Systems Command (NAVSEA) initiated an investigation of the Tarawa class (LHA-1) superheater headers due to the reoccurrence of numerous cracks and leaks in the tube to header attachment welds. A 3-dimensional solid finite element model was developed to simulate the super-heater header geometry. ADINA, a finite element program for automatic dynamic incremental nonlinear analysis, is used to evaluate the stresses present in the header particularly the stresses that are present in the tube to header welds. The model that is used evaluates the stresses induced by both pressure and thermal loadings. This is part of a continuing study of high pressure and high temperature boiler components.

**CONSTRAINED VISCOELASTIC LAYER DAMPING OF THICK ALUMINUM PLATES:
DESIGN, ANALYSIS, AND TESTING**

**Michael John Bateman - Lieutenant, United States Navy
B.S.N.A., United States Naval Academy, 1982**

Master of Science in Mechanical Engineering & Mechanical Engineer - March 1990

Advisor: Y. S. Shin - Department of Mechanical Engineering

Modern naval warfare has been increasingly dependent upon the acoustic silencing of the participants. Constrained viscoelastic layer damping of vibrating elements is one method which can be used to meet acoustic silencing goals. This paper considers constrained viscoelastic layer damping treatments applied to a thick aluminum plate, including single layer, double layer, a milled pocket plate, and a milled "floating element" configuration. High modal damping values were obtained for each damping configuration. The Modal Strain Energy method, using finite element analysis to estimate modal loss factors, was investigated for use as a tool in constrained viscoelastic layer damping design. A comparison of experimentally measured frequency response and modal loss factors with those predicted by the modal strain energy method is presented to confirm the possible use of the modal strain energy method as a design tool.

**HEAT TRANSFER, ADIABATIC EFFECTIVENESS AND INJECTANT
DISTRIBUTIONS DOWNSTREAM OF SINGLE AND DOUBLE ROWS OF FILM-
COOLING HOLES WITH COMPOUND ANGLES**

**David T. Bishop, Jr. - Lieutenant, United States Navy
B.S., University of South Alabama, 1985**

Masters of Science in Mechanical Engineering - September 1990

**Advisors: P. M. Ligrani & C. S. Subramanian - Department of
Mechanical Engineering**

Experimental results are presented which describe the development and structure of turbulent boundary layer flow downstream of single and double rows of film-cooling holes with compound angles. The film-cooling holes are inclined at an angle of 30 degrees when projected into the spanwise/normal (Y-Z) planes and at angle of 35 degrees when projected into the streamwise/normal (X-Y) planes with respect to the test surface. Three configurations are used: (1) one row of film-cooling holes with a blowing ratio of $m=0.5$, (2) one row of film-cooling holes with a blowing ratio of $m=1.0$ and (3) two staggered rows of film-cooling holes with a blowing ratio of $m=0.5$. Results indicate that the highest η values are obtained when two rows of compound angle injection cooling holes are employed with a blowing ratio of $m=0.5$, and that the lowest η values result when one row of compound angle injection cooling holes is employed with a blowing ratio of $m=1.0$. Near film cooling holes and for x/d as high as 87, streamwise mean velocity and total pressure distributions show spanwise periodicity near the wall as a result of the discrete nature of the film injection. At $x/d=10.2$, injectant distributions are non-circular in spanwise normal planes. These distributions spread in lateral and normal directions as the boundary layer convects downstream.

SOME ASPECTS OF FILM CONDENSATION OF STEAM ON FINNED TUBES

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B.S., Oregon State University, 1982

Master of Science in Mechanical Engineering - December 1989

Advisor: P. J. Marto - Department of Mechanical Engineering

Heat-transfer measurements were made for filmwise condensation of steam on smooth tubes and finned tubes with rectangular-shaped fins. The influence of fin root diameter on a single horizontal finned tube was examined by taking data for two families of tubes whose fin root diameters were 12.7 and 19.05 mm. Each family of tubes had fins that were 1 mm thick and 1 mm high, but with fin spacings of 0.25, 0.50, 1.0, 1.5, 2.0, and 4.0 mm. To compare results being obtained in a concurrent research project with Queen Mary College (University of London), data were collected on two tubes whose fin root diameters were 12.7 mm, and which had fin thicknesses of 0.5 mm, fin heights of 1.59 mm, and fin spacings of 1.0 mm. A comparison of the enhancement ratios (based on constant vapor-side temperature drop) with past Naval Postgraduate School (NPS) studies showed good agreement. The apparatus was then modified in order to study the effects of condensate inundation. Preliminary flow visualization studies of the condensate motion were made. On finned tubes, the condensate falling on the tubes has a tendency to be channeled between fins and does not spread out axially as occurs on smooth tubes.

EFFECTS OF 1 HZ IMPOSED BULK FLOW UNSTEADINESS OF LAMINAR/TURBULENT TRANSITION IN A STRAIGHT CHANNEL

Thomas M. Coumes - Lieutenant Commander, United States Navy

B.S., Oregon State University, 1976

Master of Science in Mechanical Engineering - December 1989

Advisor: P. M. Ligrani - Department of Mechanical Engineering

Laminar/Turbulent transition is studied in a straight channel with 1 Hz imposed bulk flow unsteadiness for Reynolds numbers of 1103 to 2715 and Strouhal numbers of 0.06045 to 0.02455. Channel aspect ratio is 40 to 1 with 1.27 cm height, 50.8 cm width and 4.27 m length. Observations, videos and photographs of smoke patterns show different subcritical transition events including Tollmien-Schlichting waves, vortex-array type motion evidenced by smoke swirls and ribbon like patterns, turbulent spots and fully turbulent flow. Fluctuating intensity magnitudes relative to velocities from imposed unsteadiness are determined from phase-averaged velocity traces. Of particular interest, is whether the imposed unsteadiness advances or delays transition events. With the conditions that were investigated, transition events begin to occur at lower Reynolds numbers and extend over a wider range of Reynolds numbers compared to flows with no imposed unsteadiness.

VIBRATION OF A CANTILEVER BEAM THAT SLIDES AXIALLY IN A RIGID FRICTIONLESS HOLE

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B.S., United States Coast Guard Academy, 1981

Master of Science in Mechanical Engineering - September 1990

Advisor: D. Salinas - Department of Mechanical Engineering

This research considers a cantilever beam which can move axially in and out of a rigid frictionless hole and is free to vibrate laterally outside the hole. Two Euler equations describing the lateral and axial motion of the beam are presented. A transformation of coordinates to eliminate the moving boundary, and spatial non dimensionalization are used to transform the problem into a system of two coupled non linear partial differential equations with a fixed domain. A finite element formulation provides a numerical solution to the problem. Results for some problems are presented.

**FURTHER STUDIES OF TURBULENCE STRUCTURE RESULTING FROM
INTERACTIONS BETWEEN EMBEDDED VORTICES AND WALL JETS
AT HIGH BLOWING RATIOS**

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B.S.CEM., Oregon State University, 1980

Master of Science in Mechanical Engineering - December 1989

**Co-Advisors: C. S. Subramanian & P. M. Ligrani - Department of
Mechanical Engineering**

Interactions of wall jets and vortices embedded in turbulent layers commonly occur near gas turbine blades and endwalls where film cooling is employed. These interactions frequently result in undesirable heat transfer effects at blade and endwall surfaces. In this study, a crossed hotwire probe is used to measure the turbulence structure resulting from this type of interaction. The vortex is generated using a half delta-wing vortex generator mounted at 12 degrees with respect of a 10 m/s mean velocity flow over a flat plate. A single injection hole, 0.95 cm in diameter, inclined 30 degrees to the horizontal, is positioned 59.3 cm downstream of the vortex generator. The vortex generator is positioned so that vortex upwash or downwash could be located over the injection hole. Streamwise development of the turbulent boundary layer was investigated for the following cases: (1) boundary layer with jet only ($m = 1.5$), and (2) boundary layer with vortex only. Measurement of interaction between the boundary layer, vortex upwash, and the wall jet was made at one station with various blowing ratios. At low blowing ratios ($m = 0.5$ and 1.5) the vortex dominates the flow. Significant alterations to the turbulent structure are seen in the Reynolds stress components, vorticity distributions and mean velocities. At higher blowing ratios ($m = 2.5$ and 3.5) the jet dominates the flow, the vortex is blown away from the wall, and its turbulence effects are dispersed over a larger area.

**CORROSION MECHANISMS AND BEHAVIOR OF A P-130X GR/6063 A1
COMPOSITE IN AQUEOUS ENVIRONMENTS**

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B.S., Purdue University, 1984

Master of Science in Mechanical Engineering - September 1990

Advisor: I. Dutta - Department of Mechanical Engineering

The corrosion mechanisms and behavior of a P-130x graphite fiber reinforced 6063 aluminum composite laminate were studied. Electrochemical and total immersion tests were performed on the composite in 3.5% sodium chloride and 5.0% sodium sulfate solutions. The effects of pH, the presence of sulfite ions, various heat treatments, and electrolyte aeration were investigated. Some tests were also performed on control monolithic 6063 aluminum specimens. Immersion tests showed that when graphite fibers are exposed simultaneously with the matrix, then galvanic coupling is the principal corrosion mechanism in this composite. However, if the composite cross sectional edges are sealed from contact with the environment, then pitting attack of the surface foils becomes the principal mode of attack, especially in harsh environments (chloride and sulfite ions present in addition to low pH). This form of attack can eventually lead to galvanic corrosion. Low pH and the addition of sulfite ion significantly increase the susceptibility to localized corrosion and the rates of both general and galvanic corrosion. Progressive aging of the composite matrix decreases general corrosion rates in deaerated solutions. Electrolyte aeration results in a significant reduction in the composite's resistance to all forms of corrosion.

NUMERICAL STUDY OF NON-IMPULSIVELY STARTED FLOW AROUND A CIRCULAR CYLINDER

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Master of Science in Mechanical Engineering - September 1990

Advisor: T. Sarpkaya - Department of Mechanical Engineering

The effect of constant acceleration, prior to the establishment of a steady uniform flow, on some of the characteristics of the resulting time-dependent flow about a circular cylinder has been investigated numerically. It is shown that the occurrence of a local maximum drag is dependent on the parameters characterizing the non-impulsive nature of the ambient flow. However, the onset of the wake asymmetry and the evolution of the lift and drag forces during the transient period depend on the characteristics of the numerical perturbation used to initiate the asymmetric vortex shedding. It is concluded that the numerical methods can predict, to varying degrees of accuracy, the behavior of the symmetric state and the quasi-steady-state, but not of the intermediate state.

AN INVESTIGATION OF THE AS-QUENCHED AND EARLY AGING CHARACTERISTICS OF A Al-4.1wt.% Li BINARY ALLOY BY X-RAY DIFFRACTION

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Master of Science in Mechanical Engineering - June 1990

Advisor: A. G. Fox - Department of Mechanical Engineering

The as-quenched and early aging characteristics of an as-cast, binary, Al-4.1WT.% Li alloy has been studied by X-ray diffraction. Flat plate samples were solution heat treated at 540°C under argon and ice-brine quenched. Power samples were made from flat plate samples in the as-quenched condition by filing at liquid nitrogen temperatures. Aging was conducted at 200°C on both plate and power samples. The presence of very broadened 100 superlattice reflections of $S'Al(L1_2)$ structure and small reflections of $S AlLi$ (B32 structure) were observed in the as-quenched condition for the plate sample. The power sample showed the additional 110 superlattice peak of S' and 200 S peak. This clearly showed the preferred orientation effects of the plate. From the as-quenched powder, a volume fraction of 77% S' with an average particle diameter of 53A was calculated. Long range order parameter was calculated as 0.50, indicating an almost maximum degree of order in the as-quenched condition. These results indicate that the as-quenched alloy has 77% ordered regions of about 50A surrounded by disordered matrix. Aging of both the power and plate indicated that S' particle growth follows Ostwald ripening. S peaks were observed throughout the aging process. These results support the theory of an ordering transformation followed by a spinodal decomposition during and immediately following the quench.

DESIGN AND CONSTRUCTION OF A SECOND GENERATION AUV

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Master of Science in Mechanical Engineering - December 1989

Advisor: A. J. Healey - Department of Mechanical Engineering

The design and construction of an Autonomous Underwater Vehicle (AUV) for use as a research and development testbed at the Naval Postgraduate School (NPS) is presented. Design objectives, analysis and trade-offs are discussed with respect to a generic AUV and specifically detailed for the case of the NPS AUV II. System integration and flexibility is emphasized in the subject vehicle to support presently planned and future research employment. Hull, mobility, sensor, automatic control, and energy subsystems are described. Design and fabrication techniques for the NPS AUV II vehicle hull and equipments are documented.

**EFFECTS OF 2 HZ IMPOSED BULK FLOW UNSTEADINESS ON LAMINAR/
TURBULENT TRANSITION IN A STRAIGHT CHANNEL**

**Francis J. Greco - Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1977**

Master of Science in Mechanical Engineering - December 1989

**Advisors: P. M. Ligrani & C. S. Subramanian - Department of
Mechanical Engineering**

Laminar/turbulent transition is studied in a straight channel with 2 Hz imposed bulk flow unsteadiness for Reynolds numbers of 1100 to 3800 and Strouhal numbers of 0.121 to 0.035. Channel aspect ratio is 40 to 1 with 1.27 cm height, 50.8 cm width and 4.27 m length. Observations, videos, and photographs of smoke patterns show different subcritical transition events including Tollmien-Schlichting waves, vortex-array type motion evidenced by smoke swirls, ribbon-like patterns, turbulent spots, and fully turbulent flow. Fluctuating intensity magnitudes relative to velocities from imposed unsteadiness are determined from phase-averaged velocity traces. With 2 Hz unsteadiness, transition events begin to occur at lower Reynolds numbers and extend over a wider range of Reynolds numbers compared to flows with no imposed unsteadiness.

**FURTHER DEVELOPMENTS OF FILMWISE CONDENSATION
OF STEAM ON HORIZONTAL INTEGRAL FINNED TUBES**

**Mark Brady Guttendorf - Lieutenant, United States Navy
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Master of Science in Mechanical Engineering & Mechanical Engineer - June 1990

Advisor: P. J. Marto & S. B. Memory - Department of Mechanical Engineering

Heat transfer measurements have been made for filmwise condensation of steam on three families of horizontal integral finned copper tubes. The families differ from each other in their tube root diameter (12.7mm, 19.05mm, 25.00mm). The tubes making up each family differ from each other only in the fin spacing. Similar measurements have been carried out on three smooth horizontal copper tubes of outside diameters equal to the root diameters of each family, allowing the heat transfer enhancements due to the fins to be measured directly. Results carried out under vacuum and atmospheric conditions indicate that there is a optimum fin spacing which is independent of tube root diameter and operating pressure. This optimum fin spacing is 1.5mm. Heat transfer measurements were carried out on all tubes with and without the use of a spiral insert (used to enhance the internal heat transfer). It was found that with the current processing technique used, the heat transfer enhancement for a finned tube (which is based on the outside heat transfer coefficient) varies depending on whether or not an insert is used, the enhancement being lower when no insert is used. However, it was found that when testing a smooth tube there was no difference when an insert was or was not used. There is a need to develop a more accurate correlation for the inside heat transfer coefficient. Further tests have been repeated using a finned tube geometrically similar to one being tested at the University of London. Discrepancies that existed between the two sets have been eliminated.

**A COMPARISON OF THE AGING KINETICS OF A CAST ALUMINA-6061
ALUMINUM COMPOSITE AND A MONOLITHIC 6061 ALUMINUM ALLOY**

**Johanna L. Hafley - Lieutenant, United States Navy
B.S., Pennsylvania State University, 1980**

Master of Science in Mechanical Engineering - December 1989

Advisor: I. Dutta - Department of Mechanical Engineering

Electrical resistivity and hardness measurements were conducted during isothermal aging treatments of an alumina particulate reinforced 6061 aluminum control material. Transmission electron microscopy was utilized to examine the microstructural changes accompanying the changes in the resistivity of the monolith during aging. In addition, differential scanning calorimetry was used to investigate the growth kinetics and thermal stability of the metastable phases in the control sample. From DSC experiments, the heats of formation of the metastable phases were determined as functions of aging time and temperature. These results were used to characterize the aging behavior of the matrix material.

**THERMAL AND MECHANICAL FATIGUE OF LAMINATED 6061 A1-P100
GR METAL MATRIX COMPOSITE**

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Master of Science in Mechanical Engineering - September 1990
Advisor: I. Dutta - Department of Mechanical Engineering**

Aluminum-Graphite (6061 A1/P100 Thornel fiber) composite material, with [0/90] cross plies and 40% fiber volume, was tested under thermal and mechanical cyclic loading. Initial thermal cycling experiments of a diffusion bonded, 11 ply composite showed crack nucleation at regions of poor liquid metal infiltration in the fiber tows when heated from room temperature (RT) to 540°C after one cycle, as seen using the edge replica technique. Similar experiments from RT to 100°C did not show similar damage after 120 cycles. Dilatometry experiments showed the existence of thermal residual strain after the first heating cycle between (a) RT to 100°C and (b) RT to 540°C. Thermal strain hysteresis was also observed in both temperature ranges. These effects have been explained using matrix time dependent plasticity and residual stress concepts. It was found that the residual stresses existing at RT after fabrication, due to differences in coefficient of thermal expansion of aluminum and graphite, seriously effected the subsequent strain behavior. Transmission electron microscopy revealed poor wetting of the graphite fibers due to the lack of the standard TiB₂ coating used in these composites. Finally, a different type of fabricated composite, viz., a cast, three ply composite of the same matrix and reinforcement, was studied in bend fatigue loading. Two different sample configurations, along with the monolithic matrix material, were tested in the range of 65 to 95 percent of their respective ultimate bending strengths (UBS). Crack initiation and propagation studies, along with S-N curves, are also presented. Fiber orientation was found to play a significant role in fatigue strength, and crack propagation.

**PROCESSING STUDIES OF ALUMINUM-MAGNESIUM AND ALUMINUM-
COPPER-LITHIUM ALLOYS**

**Frank J. Harsacky, Jr. - Lieutenant, United States Navy
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Master of Science in Mechanical Engineering - March 1990
Advisor: T. R. McNelley - Department of Mechanical Engineering**

Investigation into the effect on superplastic behavior of two aluminum alloys produced by variations of thermomechanical processing parameters was conducted. The alloys in this study are Al-10Mg-0.1Zr (weight percent) and 2090, which is Al-2.56Cu-2.03Li-0.12Zr (weight percent). Determination of the existence of an optimum balance between deformation and recovery for the Al-10Mg-0.1Zr alloy was accomplished by extending the annealing interval to 60 minutes during warm rolling at 300°C. The optimum balance is a 30 minute annealing interval between rolling passes. Processing of Al-10Mg-0.1Zr with a rolling temperature lower than the annealing temperature produced ductilities which are less than those obtained by utilization of the optimum process. The extension of annealing intervals in the processing of 2090 resulted in increased superplastic response when compared with results obtained employing shorter annealing intervals. By application of a two-temperature process which incorporates rolling at a lower temperature than the annealing temperature, the determination has been made that enhanced ductility results however, the annealing interval of 15 minutes should be extended.

A COMPUTATIONAL AND EXPERIMENTAL STUDY OF FLUSH HEAT SOURCES IN LIQUIDS

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Master of Science in Mechanical Engineering & Mechanical Engineer - June 1990

Advisors: Y. Joshi & S. Sathe - Department of Mechanical Engineering

A numerical investigation of two-dimensional natural convection flow and heat transfer from a substrate-mounted flush heat source immersed in a liquid-filled square enclosure was conducted. The study is relevant to direct liquid-immersion cooling of electronic components. A control volume based finite-difference model that accounts for conduction heat transfer within the substrate and heat source and the coupled natural convection in the fluid was utilized. Numerical predictions were obtained for a wide range of Rayleigh and Prandtl numbers, substrate to fluid and heat source to fluid thermal conductivity ratios and other geometrical parameters that may be encountered in practice. An increase in Rayleigh number lead to more vigorous flow and promoted cooling. No noticeable effect on the nondimensional temperatures was observed when changing the Prandtl number from 7 to 100. Little reduction in maximum temperatures was observed when substrate and component to fluid thermal conductivity ratios were increased beyond 10 and 25, respectively. Component to substrate width ratio change from .25 to .999 resulted in approximately linear decrease in the maximum temperature. A companion experimental study of three-dimensional natural convection transport from a flush mounted array of heat sources in water was also conducted. Computer temperatures compared favorably to appropriate experimental data.

PHASE TRANSFORMATIONS AND MICROSTRUCTURAL EVOLUTION IN AGED Mn-Cu BASED ALLOYS

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Master of Science in Mechanical Engineering & Mechanical Engineer - June 1990

Advisor: J. Perkins - Department of Mechanical Engineering

The transformation behavior of aged Mn-Cu-based alloys was studied via transmission electron microscopy. The evolution of several unique forms of diffraction contrast, such as "tweed" and "flickering," was characterized and correlated with the underlying transformation behavior. Convergent beam microbeam compositional analysis and high resolution lattice imaging techniques were employed to assist in the interpretations. It was determined that upon aging these alloys, a FCC solid solution decomposes into a fine dispersion of Mn-rich and Mn-poor regions which coarsen with further aging. This decomposition was modeled using finite difference techniques. The Mn-rich regions were determined to undergo a crystallographic transformation which involved a slight tetragonal distortion upon cooling. For short aging times, when the elastic strain fields around each of the finely dispersed FCT regions overlap sufficiently, tweed contrast is observed. At longer aging times, the Mn-rich regions grow and become further apart, so that the strain fields of the FCT crystallites do not overlap so much, and the tweed contrast diminishes and is replaced by a V-shaped morphology within the FCT regions which resemble a set of self-accommodating crystals. In all stages of aging, the orientation of the tetragonal c-axis is easily switched by elastic excitation, giving rise to the unique flickering contrast in the TEM.

**THE RESPONSE AND FAILURE MECHANISMS OF CIRCULAR METAL AND
COMPOSITE PLATES SUBJECTED TO UNDERWATER SHOCK LOADING**

Robert Allen Jones - Lieutenant Commander, United States Navy

B.S.M.E., Auburn University, 1977

Master of Science in Mechanical Engineering - March 1990

Advisor: Y. S. Shin - Department of Mechanical Engineering

The response and failure mechanism of circular aluminum panels and S-2 glass fiber/polyester resin matrix composite panels in response to underwater shock loading were investigated. The response of the aluminum panels was compared to the characteristic response of thin circular metal plates subjected to shock loading with a good degree of correlation. The response of the aluminum panels was then used as a reference with which to compare the response of the composite panels. The response and failure mechanism of the composite panels were found to be highly dependent on the boundary conditions of the panel. For the conditions of this test series, in which the panel boundary was allowed limited motion in the radial direction, the response of the composite panel was determined to be generally similar to the response of the aluminum panels, mitigated by the high strength in tension of the glass fiber. The failure mechanism appeared to be localized matrix failure in compression due to the high circumferential stresses generated as a result of the panel being forced into the smaller diameter test fixture by the shock wave. The radial motion of the panel edge allowed by the boundary conditions appears to have exacerbated the circumferential compressive stresses.

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 2: INJECTION BENEATH THE VORTEX UPWASH

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B.S., Royal Thai Navy Academy, Thailand, 1980

Master of Science in Mechanical Engineering - December 1989

Advisor: P. M. Ligrani - Department of Mechanical Engineering

The effects of longitudinal vortices on film-cooling injectant from a single injection hole and from a row of injection holes in a turbulent boundary layer are investigated. Attention is focussed on the effects of vortex circulation when the injection hole is located beneath the vortex upwash. Heat transfer measurements, mean velocity and mean temperature surveys, and surface flow visualization results are discussed. The embedded vortex considerably disturbs the injectant when $\Gamma/(U_c d)$ is greater than 1.0-1.5, where Γ is the vortex circulation, U_c is the injectant mean velocity and d is the injection hole diameter.

**CHARACTERIZATION OF THE CORROSION OF A P-130X GRAPHITE FIBER
REINFORCED 6063 ALUMINUM METAL MATRIX COMPOSITE**

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B.S., Rensselaer Polytechnic Institute, 1982

Master of Science in Mechanical Engineering - December 1989

Advisor: I. Dutta - Department of Mechanical Engineering

The corrosion behavior of a P-130x graphite fiber reinforced 6063 aluminum 0-90 cross plied metal matrix composite was studied. Electrochemical tests were performed on the composite and the monolithic matrix metal in aqueous 3.5% NaCl solutions. Immersion tests were performed on the composite in aqueous 3.5% NaCl solutions. The effects of pH, the presence of sulfite ions, and various heat treatments were investigated. The electrochemical tests included studies of galvanic corrosion, corrosion potential, galvanostaircase cyclic polarization and polarization resistance. Immersion tests showed accelerated corrosion at the exposed interfaces, with preferential attack at transverse fiber layers. Galvanic corrosion was large at low pH values, large graphite area fractions and when the matrix was in the over-aged state. The corrosion potential of the composite was found to be electronegative to the monolith when the Gr-Al interfaces were exposed to the electrolyte. Low pH values and over-aging increased pitting susceptibility. Solutionizing and quenching lowered pitting susceptibility at pH 8 but increased it at pH 4. Low pH values, the presence of sulfite ions and over-aging increased general corrosion rates.

**THE EFFECTS OF 1,2,3, AND 4 Hz IMPOSED BULK FLOW OSCILLATIONS
ON LAMINAR/TURBULENT TRANSITION IN A STRAIGHT CHANNEL**

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B.S., University of Wisconsin-Eau Claire, 1981

Master of Science in Mechanical Engineering - June 1990

Advisors: P. M. Ligrani & C. S. Subramanian -

Department of Mechanical Engineering

A channel with 40 to 1 aspect ratio and rectangular cross section is used to study the effects of imposed oscillations on transition from laminar to turbulent flow. Oscillations are imposed using a single rotating vane located in the flow downstream of the test section. Flows with Reynolds numbers ranging from 1100 to 3580 and Strouhal numbers from 0.0211 to 0.2418 are studied. For all cases, time averaged velocity profiles are unaffected by imposed oscillations. Imposed oscillations have a destabilizing effect on the flow near the edge of the Stokes layer. Turbulence intensity magnitudes with imposed oscillations show that transition to the turbulence begins at lower Reynolds numbers and extends over a wider range of Reynolds numbers than when no imposed oscillations are present. In addition, higher levels of intermittency are present with imposed oscillations for Reynolds numbers 1900 to 2200 at $y/d = 0.90$. At Reynolds numbers from 1450 to 1800, frequency spectra evidence high intensity intermittent turbulent fluctuations, followed and preceded by quiescent flow, both with and without imposed oscillations. A center mode of secondary instability is evidenced by high values of normalized longitudinal turbulence intensity measured in the channel center when no oscillations are imposed on the flow. Imposed oscillations are found to suppress this center mode of secondary instability, as evidenced by reductions in longitudinal turbulence intensity values near the channel center.

AUTOPILOT DESIGN FOR AUTONOMOUS UNDERWATER VEHICLES BASED ON SLIDING MODE CONTROL

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B.A., Illinois College, 1974

M.B.A., University of Central Florida, 1985

Master of Science in Mechanical Engineering & Mechanical Engineer - June 1990

Advisors: F. A. Papoulias & A. J. Healey - Department of Mechanical Engineering

An autopilot is designed using Sliding Mode Control Theory that can control the speed and heading of a full six degree of freedom, nonlinear model of the Navy's SDV Mark 9 vehicle. The control laws are based on a simplified linear model that allows speed and heading to be treated as separate systems. Once control of heading and speed is established, depth control is then achieved by a third law. Although they are developed separately, the three individual control laws act simultaneously to provide robust control of speed, heading, and depth of the nonlinear model of vehicle. Line of Sight Guidance is used to convert the way points provided by the mission planner into commands for heading to which the autopilot responds. The performance of the autopilot is evaluated over a wide range of speeds to demonstrate its robustness. In addition, the effects of current are simulated and the autopilot is modified to compensate of the presence of a strong current.

**APPLICATION OF VAX/VMS GRAPHICS FOR SOLVING PRELIMINARY SHIP
DESIGN PROBLEMS**

Gerald Keith McGowan - Lieutenant, United States Navy

B.E.E., University of Washington, Seattle, 1979

Master of Science in Mechanical Engineering - March 1990

Advisor: F. A. Papoulias - Department of Mechanical Engineering

The VAX/VMS UIS graphics library routines were used in the creation of a menu driven, interactive program which solves basic preliminary ship design problems. The program uses a menu with active mouse and keyboard to select options, enter data, and control program execution. At present, the program solves transverse and longitudinal static stability problems and predicts the effects of shifting weight in three planes. It also calculates the hydrodynamic derivatives for maneuvering performance and predicts the turning circle characteristics of the ship. Provisions for a hardcopy, detailed report are also included. Space has been allocated to include future program modules or user supplied programs.

ANTISOTROPIC TENSILE PROBABILISTIC FAILURE CRITERION FOR COMPOSITES

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B.S. (M.E.), University of Colorado-Boulder, 1982

Master of Science in Mechanical Engineering - June 1990

Advisor: E. M. Wu - Department of Aeronautics and Astronautics

A probabilistic failure criterion is needed to quantitatively predict reliability in critical applications, such as man-safe, deep-sea and air structures, and as an objective function for use in optimum design. Composites are multi-phased and anisotropic, which give rise to failure in different modes with different probabilistic occurrences that are dependent on the applied stress sensor. Statistical representation of combined stress failures is practically impossible. Probabilistic modeling must be based on the failure modes. This investigation examines the underlying features required in a probabilistic failure criterion for unidirectional fiber composite structures via Monte Carlo simulations. The interdependencies of the intrinsic strengths (associated with uniaxial loadings) and of the failure modes in a composite structure under combined tensile loading are elucidated. The joint distribution function for composite failure due to a proportional loading regime is derived starting from the representation of the physical failure process in Boolean operations which, in turn, is represented by probability functions. Specific forms of the probability functions for different failure modes are suggested.

THE EFFECTS OF EMBEDDED LONGITUDINAL VORTICES ON HEAT TRANSFER IN A TURBULENT BOUNDARY LAYER WITH FILM COOLING FROM HOLES WITH COMPOUND ANGLES

Stephen W. Mitchell - Lieutenant, United States Navy

B.S.E., Tulane University, 1984

Master of Science in Mechanical Engineering - September 1990

**Advisors: P. M. Ligrani & C. S. Subramanian - Department of
Mechanical Engineering**

The effects of embedded longitudinal vortices on film cooling injectant from one row and two rows of holes with compound angles are investigated. Holes are designed such that their angle from the test surface is 30 degrees in a spanwise/normal plane projection, and 35 degrees in a streamwise/normal plane projection. A blowing ratio of 0.5, non-dimensional injection temperature parameter of 1.29 to 1.38, and freestream velocity of 10 m/s are employed. As the spanwise position of the vortex is altered, Stanton numbers change considerably depending upon which portion of each vortex is proximate to film injection holes. These variations are vastly different depending on whether or not spanwise components of the vortex secondary flows are opposed or aligned with the spanwise direction of the injectant. Mean velocity surveys, injection distribution surveys, and flow visualization results are also discussed.

AUTOMATIC CONTROL OF STRAIGHTLINE MOTIONS OF TOWED VESSELS

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B.S., United States Naval Academy, 1983

Master of Science in Mechanical Engineering - March 1990

Advisor: F. A. Papoulias - Department of Mechanical Engineering

A classical control system with a full-order observer is designed to stabilize the motions of towed vessels. the control method is transverse movement of the towline attachment point on the towed vessel. The linearized sway and yaw equations of motion are developed, leading to the control system design. The control system is tested using MATRIXx. Results for a barge, a marinerclass ship and a tanker are presented. Possible benefits of the implementation of such a system include improved fuel economy, a wider range of environmental conditions during which towing operations can be conducted, and improved safety.

**ENHANCED VAX/VMS PROGRAMMING SOLUTIONS WITH APPLICATIONS
FOR PRELIMINARY MARINE VEHICLE DESIGN**

**James R. Plosay - Lieutenant, United States Navy
B.S., Nuclear Engineering, Pennsylvania State University, 1983
Master of Science in Mechanical Engineering - September 1990
Advisor: F. A. Papoulias - Department of Mechanical Engineering**

A Mechanical Engineering Department project in which the VAX/VMS system was utilized to create an interactive menu driven program to solve basic preliminary ship design problems. Enhancement of an existing program was initiated to improve the user interface by adding user-friendly help information. Also, routines were written to calculate propulsive power requirements based upon the ship from coefficients selected and comparisons made using the Method of Silverleaf and Dawson and the Admiralty Coefficient prediction method. Further computational routines were added to predict range and endurance figures for estimated voyage data and selected propulsion plant types, using the U.S. Navy Design Data Sheet DDS9400-1 methodology. Finally, the detailed printed report generated by the system was updated to include reports of these calculations for the users design study.

STATISTICAL APPROACH TO FAULT DETECTION OF GEARS

**John D. Robinson - Lieutenant, United States Navy
B.S.E.E., United States Air Force Academy, 1981
Master of Science in Mechanical Engineering - December 1989
Advisor: Y. S. Shin - Department of Mechanical Engineering**

The cost associated with machinery maintenance is a major portion of operating expenses. Vibration analysis, used as a method of monitoring the condition of machinery, provides a means to identify machinery faults before significant levels of damage occur. The results of research using statistical parameters of the vibration signal produced by machinery is presented. The statistical parameters investigated included the mean, mean square, variance, and coefficients of skewness and kurtosis. These values are compared with results of spectrum analysis techniques similar to methods used by the United States Navy in machinery monitoring programs. The investigation focuses on the use of band limited statistical parameters used as a fault detection technique that permits machinery operation to be categorized as "satisfactory" or "unsatisfactory".

**A METHOD FOR MACHINERY CONDITION MONITORING OF TRANSIENT
PHENOMENA USING THE PSEUDO WIGNER-VILLE DISTRIBUTION**

**Graham W. Rossano - Lieutenant, United States Navy
B.S.M.E., United States Naval Academy, 1983
Master of Science in Mechanical Engineering - June 1990
Advisors: Y. S. Shin & J. F. Hamilton - Department of Mechanical Engineering**

The Pseudo Wigner-Ville Distribution is a time frequency representation of an input time signal and is ideally suited for portraying non-stationary signals. A working computer program is presented and the effect of preprocessing and postprocessing data manipulations is shown. The program has been developed for analyzing data for use in machinery condition monitoring and diagnostics and will be a valuable asset for analyzing transient machinery. A practical example pump speed variations with time is also presented. Due to the fact that the Pseudo Wigner-Ville Distribution can be used to analyze both steady and transient operations, along with the fact that it can be calculated on virtually any computer, this method could revolutionize machinery condition monitoring and diagnostics.

PERFORMANCE OF SMALL THRUSTERS AND PROPULSION SYSTEMS

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B.S., Aero.E., Iowa State University, 1977

Master of Science in Mechanical Engineering - March 1990

Advisor: A. J. Healey - Department of Mechanical Engineering

Performance tests of the longitudinal and lateral propulsion devices for use on the Naval Postgraduate School (NPS) Autonomous Underwater Vehicle (AUV) II are presented. The propulsion requirements for the AUV are discussed and a brief review of the theoretical performance of propulsors is presented. The test procedures used to determine the operating range characteristics of the candidate propulsion devices are described and the results are compared with those obtained theoretically as well as with the parameters of large marine propulsion systems. The results of simulations of longitudinal motion using a non-linear model of the AUV are documented, providing an initial estimate of vehicle acceleration/deceleration performance.

THERMOMECHANICAL PROCESSING AND AMBIENT TEMPERATURE PROPERTIES OF A 6061 ALUMINUM 10 VOLUME PERCENT ALUMINA METAL MATRIX COMPOSITE

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B.S., United States Naval Academy, 1984

Master of Science in Mechanical Engineering - March 1990

Advisor: T. R. McNelley - Department of Mechanical Engineering

Thermomechanical processing was conducted on a cast aluminum-based metal matrix composite. The material studied was a 6061 aluminum containing 10 volume percent of alumina (Al_2O_3) particles, fabricated by casting and subsequently extruded by DURALCAN, Inc. Processing included isothermal rolling of an extruded bar to large strain values. As a result of rolling at 500°C, strength was increased, but with a substantial loss of ductility. Further strengthening was realized by rolling at 350°C and no further ductility loss was seen. Homogeneity of the particle dispersion was considerably improved with no evidence of microstructural damage. Upon subsequent solution heat treatment, ductility of the rolled materials was restored to values greater than obtained in material experiencing only extrusion. Also, the strength of the rolled material exceeded that of material heat treated after extrusion. Upon subsequent aging treatment (aging at 160°C), the increased strength and ductility enhancement persisted.

VALIDATION OF A COMPUTATIONAL MODEL FOR AUTOGENOUS ARC WELDING

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B.S.A.E., United States Naval Academy, 1981

Master of Science in Mechanical Engineering and

Mechanical Engineer - March 1990

Advisor: Y. Joshi - Department of Mechanical Engineering

A three dimensional transient computational model of heat transfer during gas tungsten arc welding is generalized, and then validated by comparison to Rosenthal's solution for moving point sources of heat. The current version of the code allows much greater flexibility in the specification of the thermal input from the arc. The resulting surface temperature profiles and fusion zone shapes are compared to those measured experimentally for several input power levels for autogenous gas tungsten arc welding. Arc efficiency is experimentally determined using change of phase of a liquid fluorocarbon. The model is shown to be useful for modeling autogenous welding of thick plates. Weld seam misalignment and surface flaw detection are shown to be possible ahead of the arc with accurate surface temperature detection methods. The potential of the model for creating a database of fusion and heat affected zone sizes, temperature profiles, and cooling rates for various materials, processes, and power levels is indicated.

**EFFECT OF THERMAL RESIDUAL STRESSES ON THE STRESS-STRAIN
BEHAVIOR OF METAL-MATRIX COMPOSITES**

John D. Sims - Lieutenant, United States Navy

B.S., University of Florida, 1984

Master of Science in Mechanical Engineering - September 1990

Advisor: I. Dutta - Department of Mechanical Engineering

A parametric study was conducted to assess the effect of thermal residual stresses on the stress-strain response of a fiber-reinforced metal-matrix composite. The material chosen for investigation was the SiC-whisker reinforced Al 6061 system. The effects of fiber volume fraction, fiber aspect ratio and fiber spacing were analyzed within the framework of axisymmetric finite-element models to determine the overall constitutive response of the composite as well as to solve for local field quantities in the fiber and matrix. The composite was modeled as a periodic array of cylindrical fibers, laterally aligned in one model and staggered in the other. Perfect interfacial bonding and complete fiber alignment with the tensile axis were assumed. The results indicated that (1) composite stiffness, yield strength and work-hardening rate increased with increasing volume fraction and fiber aspect ratio and (2) variations in fiber spacing primarily affect work-hardening rate and have negligible effect on composite stiffness. It was found that the presence of residual stresses affected the stress-strain behavior of the composite by influencing the load transfer characteristics between the matrix and fiber as well as the initiation and growth of plastic deformation in the matrix.

**LOCAL AND SPATIALLY AVERAGED HEAT TRANSFER DISTRIBUTIONS IN A
CURVED CHANNEL WITH A 40 TO 1 ASPECT RATIO FOR DEAN NUMBERS FROM 50 TO 200**

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B.S., Iowa State University, 1982

Master of Science in Mechanical Engineering - March 1990

Advisor: P. M. Ligrani - Department of Mechanical Engineering

The effects of curvature and the resulting centrifugal instabilities on local heat transfer distributions are studied in a curved channel at Dean numbers ranging from 50 to 200. The channel has a rectangular cross section of 1.27 cm by 50.1 cm giving an aspect ratio of 40 to 1. Flow is heated in a straight portion of the channel prior to the curved portion in order to obtain flow which is hydrodynamically and thermally fully developed. All baseline tests confirm techniques employed and qualify flow behavior. These consist of energy balances checks and comparison of results from the straight section to numerical and analytic solutions. Nusselt numbers in the curved section initially show an abrupt decrease after the imposition of the stabilizing influences of convex curvature. These are followed by a gradual increase as centrifugal instabilities and Dean vortices form and develop. Spatially resolved results also show significant surface Nusselt number variations across the span of a vortex pair, especially on the concave surface. On the convex surface, local Nusselt numbers are much more apt to be spanwise uniform.

**INTERACTION OF A VORTEX PAIR WITH A FREE SURFACE:
MEASUREMENTS AND COMPUTATIONS**

Peter B. R. Suthon - Lieutenant, United States Navy

B.S.E., Tulane University, 1983

Master of Science in Mechanical Engineering & Mechanical Engineer - June 1990

Advisor: T. Sarpkaya - Department of Mechanical Engineering

An investigation of the interaction of two counter-rotating vortices with a free surface has been undertaken. Experiments were carried out in two water basins and in a long towing tank through the use of measurements, flow visualization, and an infra-red camera. The results have shown that all types of vortex pairs over a wide range of Froude Numbers give rise to three-dimensional surface disturbances, known as scars and striations. The striations are a consequence of the short wavelength instability inherent to the vortex pair itself. The scars are transported outward by the vortex pair and are comprised of a constellation of coherent vortical structures (whirls). The experiments have provided sufficient understanding of the physics of the phenomenon and led to the development of a numerical model based on vortex dynamics. This model proved to be capable of explaining the physical processes involved in the evolution of the three-dimensional footprints of the vortex pair.

**DYNAMICS AND CONTROL OF MULTI-LINK ROBOT MANIPULATORS
WITH JOINT FLEXIBILITY**

**Peng-Han Wang - Lieutenant Commander, Taiwan Navy
B.S., Taiwan Naval Academy, 1980**

Master of Science in Mechanical Engineering - December 1989

Advisor: L. W. Chang - Department of Mechanical Engineering

This thesis presents the dynamic modeling and its application to the multi-link robot manipulators with joint flexibility. The twist angles of springs are utilized to model the joint flexibility. A direct dynamic model is derived by the Lagrangian method and the Newton-Euler algorithm is used for deriving the inverse dynamics. A motion controller is designed by the computed torque method based on the inverse dynamics. A recursive estimator is included in the control design to estimate the required feedback signals which are not directly measurable.

**EXPERIMENTAL STUDIES OF CIRCULAR VISCOELASTIC WAVEGUIDE
ABSORBERS FOR PASSIVE STRUCTURAL DAMPING**

**Stephen J. Watson - Lieutenant, United States Navy
B.S.M.E., United States Naval Academy, 1982**

Master of Science in Mechanical Engineering - December 1989

Advisor: Y. S. Shin - Department of Mechanical Engineering

The U.S. Navy continues to investigate and develop better methods for ship noise and vibration reduction. One such method is the introduction of waveguide absorbers. This research is a continuation with the use of viscoelastic waveguide absorbers as a means of reducing the vibrational energy developed within a plate like structure, such as a ship's hull between frames and longitudinals. The effects of temperature and size of circular viscoelastic waveguide absorbers, on the driving point impedance were studied and the test results were compared with a previously developed computer prediction model with very favorable agreement. A study for the development of the scheme for the selection of waveguide absorbers and for the decision of the attachment locations for the maximum vibration reduction based on the waveguide absorber loss factor equation was also performed. One, two, and three waveguide absorbers were attached to a vibrating plate as chosen locations based on impedance matching and plate velocity, to confirm the use of the loss factor equation. Experimental results showed significant reduction of vibration at resonant frequencies.

**AN EXAMINATION OF DELTA PRIME GROWTH IN AN ALUMINUM-LITHIUM ALLOY
BY X-RAY DIFFRACTION**

**Clark E. Whitman - Lieutenant, United States Navy
B.S., Wright State University, 1979**

Master of Science in Mechanical Engineering - March 1990

Advisor: A. G. Fox - Department of Mechanical Engineering

A previously manufactured hot rolled sheet of Al-Li-Zr alloy of composition Al-2.5%Li-15%Zr, by weight, was solution treated and artificially aged at 194°C from 0 to 32 hours. X-ray diffraction analysis of the alloy was conducted to observe the growth characteristics of the delta prime precipitate (the precipitate hardening phase). Transmission electron microscopy was used to verify X-ray results. Significant superlattice intensity and line broadening occurred in the as-quenched sample. This observation supports a possible order/disorder reaction and a spinodal decomposition as opposed to the typical nucleation and precipitation reaction usually observed in a precipitation hardened alloy. The Scherrer equation was used to determine delta prime particle size from diffraction line broadening, and this size was found to coarsen following conventional Ostwald ripening theory once the initial effects of the spinodal had aged out. The delta phase (considered cause of low toughness) was observed in the as quenched sample and throughout the heat treatment. It was surmised that this may be the origin of the low short-transverse fracture toughness which is typical of some of these alloys.

**MASTER OF SCIENCE
IN
METEOROLOGY**

TOVS SATELLITE SOUNDINGS OF THE ERICA IOP-2 CYCLONE

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B.S., The Pennsylvania State University, 1983

Master of Science in Meteorology - June 1990

Advisor: C. H. Wash - Department of Meteorology

Satellite soundings from the TIROS/N Operational Vertical Sounder (TOVS) are used to study the Experiment on Rapidly Intensifying Cyclone over the Atlantic (ERICA) Intensive Observation Period-2 (IOP-2), 13-14 December 1988. TOVS data are compared with dropwindsondes and coastal rawinsondes, and Spectral Grid Model (SGM) analyses of stability, geopotential height, and temperature. The impact of the first guess of the TOVS retrieval is studied by comparing four first-guess methods: (1) regression without surface data; (2) regression with surface data; (3) climatology with surface data; and (4) SGM analyses with surface data. Ship reports and moored and drifting buoys were objectively analyzed to obtain the surface data for the first guess. The retrievals with 6-h old SGM analyses as a first guess best captured the low level structure of the in situ soundings. The TOVS stability analyses defined the rapid cyclogenesis environment, in advance of the developing cyclone. The TOVS height and temperature analyses successfully described the structure of the developing cyclone, in reasonable agreement with experimental data and synoptic-scale analyses.

MULTIPLE CHANNEL SATELLITE ANALYSIS OF CIRRUS

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Master of Science in Meteorology - June 1990

Advisor: C. H. Wash - Department of Meteorology

The split-window technique is based on the varying radiative properties of cloud and the atmosphere in different wavelengths of the primary infrared (IR) window. Channels 4 (11 micron) and 5 (12 micron) on the NOAA AVHRR are used to apply the technique to determine the differences between thick and thin cirrus and multiple layered clouds. The brightness temperature from channel 5 was subtracted from the brightness temperature from channel 4, resulting in a brightness temperature difference (BTD) image. The technique was applied to ten subscenes over mid-latitude land areas for both summer and winter cases. The BTD values were compared to surface observations of the same time period as the images. The cases were grouped into five and then three cloud groups based on the surface observations. The analysis of variance showed that the average BTD values for the three cloud groups were statistically different for the summer cases, but not for the winter cases. The BTD thresholds estimated from these cases are: (1) Multiple layered clouds-0.00 to 0.08; (2) Thick cirrus-0.81 to 1.50 and (3) Thin cirrus-1.51 and greater. The split-window technique is successful in distinguishing the varying cirrus thicknesses when the surface temperature is warmer than 285 K.

**MASTER OF SCIENCE
IN
METEOROLOGY
AND
OCEANOGRAPHY**

**ACOUSTIC TOMOGRAPHIC ESTIMATE OF OCEAN ADVECTIVE HEAT FLUX:
A NUMERICAL ASSESSMENT IN THE NORWEGIAN SEA**

Richard Timothy Barock - Lieutenant Commander, United States Navy

M.S., University of Southern California, 1985

B.S., University of Notre Dame, 1978

Master of Science in Meteorology and Physical Oceanography - June 1990

Advisor: C.-S. Chiu - Department of Oceanography

In a computer simulation experiment, acoustic tomography is assessed as a means of measuring the seasonal flux of heat advected by the Norwegian Atlantic Current. Oceanic heat flux has traditionally been measured by various direct or indirect techniques that are prone to error or large uncertainty. The tomographic technique offers distinct advantages over conventional methods in that temperature and current fields, that combine to yield heat flux in the ocean, can be determined at various spatial and temporal scales. The adequacy of the tomographic technique thus hinges on the question of "how well can the temperature and current be resolved spatially?" The spatial resolution of tomography varies with array size, number of transceivers and the characteristics of the sound channel. In the assessment, we use the General Digital Environmental Model (GDEM), a climatological data base, to simulate an ocean area $550 \times 550 \text{ km}^2$ off the Norwegian Coast. Resolution and Variance analysis are performed on two circular arrays consisting of 6 transceivers. An important finding is that the horizontal resolution lengths of the current and temperature fields differ. For a six element array diameter for the current field, whereas for the temperature field it is one sixth the array diameter. We then generate synthetic travel time data that have embedded within the temperature and current signals as well as random noise. We invert the synthetic travel time data to form estimates of the original fields using a linear optimal estimator based on the Gauss-Markoff theorem. We relate the sound speed perturbation field to potential temperature and compare these estimates to the original values. Finally we use the estimated fields to compute heat flux across a transect located within the array. We compare the actual to the estimated heat flux to assess the quality of the tomographically derived value. We have found that the quality of the heat flux estimates depends critically on how well the flow field is resolved. A six element array can adequately resolve the current in the Norwegian Sea, provided that its diameter is shorter than 250 km. Such an array is able to measure net heat flux through a transect at the center of the array with only a 10% error.

OCEANIC MIXED LAYER ENTRAINMENT ZONE DYNAMICS

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B.S., United States Naval Academy, 1980

Master of Science in Meteorology and Physical Oceanography

September 1990

Advisor: R. W. Garwood - Department of Oceanography

The Naval Postgraduate School mixed layer model is augmented to include an entrainment zone with finite thickness. The role of entrainment shear production of turbulent kinetic energy is investigated by comparing model results that include the new entrainment zone with observations at Ocean Weather Station Papa in the North Pacific and with model predictions that do not include the new entrainment zone feature. Although it is not yet clear that annual-period model forecasts are improved significantly, it is shown that the entrainment zone processes play a significant role in vertical fluxes and in the turbulent kinetic energy budget of the upper ocean under warming conditions. Furthermore, it is found that the improved entrainment zone more accurately reproduces the temperature gradients of transient thermoclines observed at OWS Papa.

**SATELLITE OBSERVATIONS OF AEROSOL VARIATIONS IN THE CENTRAL
NORTH PACIFIC OCEAN**

**Tod D. Benedict - Lieutenant Commander, United States Navy
B.A., The Citadel, 1976**

**Master of Science in Meteorology and Physical Oceanography -
December 1989**

Advisor: P. A. Durkee - Department of Meteorology

A study of aerosol variations in the Central Pacific was conducted utilizing NOAA-9 AVHRR data and concurrent shipboard measurements from the NOAA R/V OCEANOGRAPHER during the RITS-88 cruise. The transect was conducted 7 April to 5 May 1988 along longitude 170° W from latitude 50° N to 12° S. Aerosol physiochemistry measurements were provided every 1° of latitude. Satellite observations of optical depth, Aerosol Particle Size Index (S12), channel 1 (0.63 μm), and channel 3 (3.7 μm) low cloud reflectances were analysed. These parameters were evaluated during several naturally occurring events, foremost of which were the Gobi desert dust storms and the eruption of Kilauea volcano. By comparing shipboard and satellite data, satellite retrieval techniques were verified, shipboard measurements were expanded to a regional scale, and the relationship between solar reflectance and the microphysical properties of clouds was verified.

THE JAN MAYEN CURRENT AND THE DEEP WATERS OF THE GREENLAND BASIN

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B.S., United States Naval Academy, 1982**

Master of Science in Physical Oceanography and Meteorology - September 1990

Advisor: R. H. Bourke - Department of Oceanography

During September 1989 the USNS BARTLETT occupied a dense array of 48 high-quality CTD stations in the Greenland Basin to characterize the Jan Mayen Current (JMC) system as part of the Greenland Sea Project. Hydrographic analyses characterize the JMC by an eastward bowing of East Greenland Current (EGC) waters in the form of a surface Polar Water (PW) tongue, a near-surface (~50m) core of modified Polar Water, and an intermediate (~100 m) core of Atlantic Water displaced ~75 km northward of the PW core. In contrast, the Greenland Sea Gyre is very weakly stratified aside from a thin surface gradient. Historical data demonstrate the JMC axis to move ~100 km north and south of its 1989 observed position near 74°N and show that upper water column temperatures and salinities were significantly lower in 1989 and 1982 than in 1958, possibly indicating an anomalous excess of PW in 1989 and 1982 compared with 1958. The dynamic height pattern (0-1000 dbar) supplemented with Lagrangian ice drift rates reveal the JMC as partly an anticyclonic meander in the EGC; the drifters indicate a significant barotropic component. Baroclinic transport estimates yield a 2 Sv initial eastward transport by the JMC. This transport results in an annual freshwater excess of 1.4 m over the survey area which equates to roughly one fourth of the annually available fresh water in the EGC. Deep water analyses show that isopycnal mixing of Eurasian Basin Deep Water and Greenland Sea Deep Water to yield Norwegian Sea Deep Water occurs within the Greenland Basin. Historical data indicate no appreciable inter-annual fluctuation in deep water properties occurs between 1958 and 1989.

**EVALUATION OF THE SSM/I RAIN ANALYSES FOR SELECTIVE
STORMS IN THE ERICA PROJECT**

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B.S., United States Naval Academy, 1982**

**Master of Science in Meteorology and Physical Oceanography
September 1990**

Advisor: C. H. Wash - Department of Meteorology

Evaluation of the SSM/I HAC precipitation algorithm is presented. SSM/I rainrate data from five passes during ERICA IOP 2 and 3 were compared to all available ship observations, dropwindsonde soundings and coastal radar. Four different techniques were applied to the seven SSM/I channels to analyze the rain rate. They are: SSM/I HAC algorithm, the Tb(19H) GHz channel with a threshold of 160° K, the Tb(37H) GHz channel with a threshold of 190° K, and the Tb(37V-37H) image with a threshold of less than a 30° K difference. For the two IOP 2 passes the Spencer et al (1989) Polarized Correction Temperature (PCT) algorithm using the two 85 GHz channels was also studied. There is considerable uncertainty in the interpretation of the SSM/I HAC rain rate algorithm. Specifically large areas of out-of-limit values are present in the vicinity of mid-latitude winter cyclones. Study of the SSM/I HAC rain rate has indicated the out-of-limit areas occur when the rain flag is triggered, but the calculated rain rate from the HAC algorithm is less than zero. From this study it is obvious that the four channel SSM/I HAC regression algorithm, in its current form, can not satisfactorily analyze the precipitation. Further study is needed to determine if a regression equation can be used to estimate precipitation areas, particularly those with light precipitation. Treating the out-of-limits values as light precipitation would dramatically improve the quality of the SSM/I HAC analysis. However, if a regression equation can not be used to estimate precipitation, using the Tb(37H) channel for a better overall analysis of light precipitation and showers and the Tb(19H) channel for a better analysis of the moderate to heavy precipitation is a viable solution.

**EFFECTS OF THE NORTHEAST MONSOON ON
THE EQUATORIAL WESTERLIES OVER INDONESIA**

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B.S., Taiwan Provincial College of Marine and Oceanic Technology

Master of Science in Meteorology and Oceanography - June 1990

Advisors: M. S. Peng and C.-P. Chang - Department of Meteorology

The possible cross equatorial influences of the Northern Hemisphere on the zonal wind along 10°S in the Indonesia-Arafura Sea region are studied by using a 14-year data set. Composites of time series of individual circulation parameters and surface flow charts reveal a correlation between the northeastern monsoon of the Northern Hemisphere and the Southern Hemisphere summer monsoon. The correlation is significantly stronger during the middle season compared to late season. During the late season, distinct patterns of changes are found in the Australian monsoon trough and upper tropospheric flow. This reflects a stronger connection between summer monsoon and midlatitude baroclinic systems within the Southern Hemisphere. Thus the mid-season events of the southern monsoon wind strengthening are more influenced by surges in the northeast monsoon in the Northern Hemisphere, while the late-season events may be due to midlatitude baroclinic effects in the Southern Hemisphere rather than the northern cold surges.

A DAY IN THE LIFE OF A WARM FRONT

Susan A. Davies - Lieutenant Commander, United States Navy

B.A., University of California, San Diego, 1980

Master of Science in Meteorology and Physical Oceanography - December 1989

Advisor: W. A. Nuss - Department of Meteorology

Three numerical model simulations of cyclogenesis are compared to examine the role of boundary layer stratification in enhancing the components forcing the ageostrophic circulation of an idealized warm front. The Sawyer-Eliassen diagnostic equation is applied to examine the contributions of frictional forcing and diabatic heating, as well as confluent and shear geostrophic deformation, to forcing of the secondary circulation of a warm front. The surface heat and moisture flux distributions are varied in each case, in order to evaluate the effect on each component as well as the cyclogenesis. Results confirm previous studies that geostrophic deformation forces strong frontogenesis at the surface, and at mid-levels frontogenesis is weaker and forced primarily by latent heat release. Frontogenetical forcing is modified by small-scale frictional forcing and diabatic heating, which depend upon the surface and boundary layer process. Although frictional forcing comprises less than five percent of total forcing of the warm front, it apparently enhances frontogenesis, partially due to indirect effects on other more dominant processes. The intensity of frictional forcing is strongly dependent on the surface heat flux distribution and track of the cyclone relative to the sea-surface temperature gradient. In the absence of surface fluxes, frictional forcing is negligible. Surface forcing due to diabatic heating is frontolytical, and reduces to forcing at low levels by about twenty percent. The magnitude of the frontolytical forcing by diabatic heating at low levels is only partially dependent on the surface heat and moisture flux distribution. Even in the absence of surface heat and moisture fluxes, the frontolytical forcing persisted, suggesting problems with the cumulus parameterization or errors in the computation of this term. These results remain to be verified against an actual case study of a warm front.

A DIAGNOSTIC STUDY OF THE VELOCITY STRUCTURE OF A MEANDERING JET USING A PRIMITIVE EQUATION MODEL WITH DYNAMIC MODE INITIALIZATION

Roland E. de Jesus - Lieutenant Commander, United States Navy

B.S., United States Naval Academy, 1980

Master of Science in Meteorology and Physical Oceanography

September 1990

Advisors: R. L. Haney & T. P. Stanton - Department of Meteorology

A high resolution, 20-level, primitive equation (PE) model of the California coastal region is initialized using temperature data acquired during the first Naval Postgraduate School California transition Zone (CTZ) cruise from 6 to 12 July 1988 for the purpose of a diagnosing the three-dimensional dynamically balanced flow field for the region. The major feature in the region during the cruise period was a strong meandering jet which flowed equatorward and offshore, oriented in a northeast to southwest direction. The quality of data acquired during cruise CTZR1 is sufficiently high to enable diagnosis of the horizontal (baroclinics) and vertical velocity field using the numerical model. The measured (ADCP) currents showed more details of the flow at deeper depths than the model, which showed a broader baroclinic flow at depth and a level of no motion near 300 m. The maximum surface velocities from model and ADCP cross-sections agreed to within 10 cm sec⁻¹ except for leg G, in which ADCP velocity was greater than the model velocity by about 30 cm sec⁻¹. The sign of vertical velocity agrees very well with independent estimates made from bio-optical data; however, the magnitude calculated by the model is 30 to 60 times larger than that estimated from the bio-optical observations.

**FORECASTING TROPICAL CYCLONE RECURVATURE USING AN EMPIRICAL
ORTHOGONAL FUNCTION REPRESENTATION OF VORTICITY FIELDS**

Debra M. Ford - Lieutenant Commander, United States Navy

B.S., University of Wisconsin - La Crosse, 1978

Master of Science in Meteorology and Oceanography - September 1990

Advisors: R. L. Elsberry & P. A. Harr - Department of Meteorology

An empirical orthogonal function (EOF) representation of relative vorticity is used to forecast recurvature (change in storm heading from west to east of 000°N) of western North Pacific tropical cyclones. The time-dependent coefficients of the first and second EOF eigenvectors vary in a systematic manner as the tropical cyclone recurves around the subtropical ridge and tend to cluster about the same values at recurvature time. In contrast, the coefficients for straight-moving storms tend to cluster about the same values at recurvature time. In contrast, the coefficients for straight-moving storms tend to cluster in a different region in EOF space. Exploiting this Euclidean distance approach, additional EOF coefficients are identified that best represent the vorticity fields of recurving and straight-moving storms. Classification of an individual case is then into the closest time-to-recurvature in 12-h intervals or straight-moving storm category as measured in multidimensional EOF space. Although rather subjective, the Euclidean method demonstrates skill relative to climatological forecasts. A more objective discriminant analysis technique is also tested. A final version that involves the first six EOF coefficients of the 250 mb vorticity field is useful (72% correct) in identifying recurvers or straight-movers during the 72-h forecast period. Skill in classifying situations within 12-h time-to-recurvature groups is low, but might be improved using other analysis techniques or in combination with other predictors.

SEE ICE CLASSIFICATION USING SYNTHETIC APERTURE RADAR

Frank W. Garcia, Jr. - Lieutenant Commander, United States Navy

B.S., University of South Carolina, 1979

Master of Science in Meteorology and Oceanography - June 1990

Advisor: J. A. Nystuen & R. H. Bourke - Department of Oceanography

This study employs Synthetic Aperture Radar (SAR) imagery from the Marginal Ice Zone Experiment (MIZEX) 1987 to identify an optimal set of statistical descriptors that accurately classify three types of ice (first-year, multiyear, odden) and open water. Two groups of statistics, univariate and texture, are compared and contrasted with respect to their skill in classifying the ice types and open water. Individual statistical descriptors are subjected to principal component analysis and discriminant analysis. Principal component analysis was of little use in understanding features of each ice and open water group. Discriminant analysis was valuable in identifying which statistics held the most discriminating power. When combined, univariate and texture statistics classified the groups with 89.5% accuracy, univariate alone with 86.8 accuracy and texture alone with 75.4 accuracy. Range and inertia were the strongest univariate and texture discriminators with 74.6% and 50.8% accuracy, respectively. Despite the use of non-calibrated SAR, univariate statistics were able to classify the images with greater accuracy than texture statistics.

**AIRCRAFT OBSERVATIONS OF THE ATMOSPHERIC BOUNDARY LAYER IN THE
VICINITY OF THE MARGINAL ICE ZONE UNDER CONDITIONS OF FLOW
PARALLEL TO THE ICE EDGE**

**Teresa M. Gobel - Lieutenant, United States Navy
B.A., Ithaca College, 1975**

Master of Science in Meteorology and Oceanography - September 1990

Advisor: W. J. Shaw - Department of Meteorology

This paper describes aircraft observations made with the NOAA P-3 research aircraft on 24 March 1989. The measurement region was over the marginal ice zone, southeast of Spitzbergen, between 74 to 76° N and 19 to 27° E. Above the atmospheric boundary layer, the geostrophic wind was 12 ms-1 at approximately 15° off-ice. A well mixed layer extended along the entire 200 km flight path which was perpendicular to and centered over the ice edge. There was a stratocumulus layer over the ocean which decreased in thickness towards the ice. The associated inversion, which coincided with the cloud layer top, continued to decrease in height over the ice. This caused a strong thermal wind effect within the atmospheric boundary layer. The near-surface geostrophic wind decreased from approximately 12 ms-1 over the ocean to 5 ms-1 over the ice due to the horizontal temperature gradient and sloping inversion.

**TRANSPOLAR SEA ICE DRIFT IN THE VICINITY OF THE YERMAK
PLATEAU AS OBSERVED BY ARCTEMIZ 86 BUOYS**

**Paul Joseph Hoffman - Lieutenant, United States Navy
B.S., University of Washington, 1983**

**Master of Science in Meteorology and Physical Oceanography
March 1990**

Advisor: J.-C. Gascard - Department of Oceanography

Strong diurnal tidal currents, in a region dominated by semidiurnal tidal surface displacements, were observed in the record of ARCTEMIZ 1986 buoys as they drifted over the Yermak Plateau, a submarine feature northwest of Svalbard. Similar diurnal currents in this area were first observed from observations taken during the FRAM III and FRAM IV ice station drift experiments. The selective enhancement of topographic vorticity waves by resonant forcing from the K1 diurnal tide over the steeply sloping northern, northwestern and western flanks of the plateau is forwarded as an explanation for these anomalously strong diurnal currents. Diurnal loops were observed in the trajectories of two buoys while they were over the northern flank of the Yermak Plateau. These loops were similar to those observed during MIZEX 84. The loops occurred during diurnal clockwise velocity peaks which have the same periodicity as the fortnightly (spring-neap) beat of surface height inequality caused by the superposition of the two principal semidiurnal tides. Sea ice forced by the added convergent grinding motion arising from these enhanced diurnal clockwise currents should have a surface morphology observably different from ice which did not flow through this area, i.e., that which passes through Fram Strait to the west of the Yermak Plateau.

OBSERVATIONS AND MODELING OF CURRENTS WITHIN THE MONTEREY BAY DURING MAY 1988

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B.S., Kutztown State College, 1978

Master of Science in Meteorology and Oceanography - June 1990

Advisor: S. R. Ramp - Department of Oceanography

The last week of April and first week of May 1988 along the central California coast were characterized as a period of strong coastal upwelling produced by moderate to strong northwesterly winds present throughout the period. A product of this upwelling event was the manifestation of a southward geostrophic jet which extended to a distance of approximately 50 km from the coast. During the period from 08 to 11 May 1988, a hydrographic survey consisting of 17 stations each occupied four to five times was conducted within the Monterey Bay. Internal Waves, with amplitudes of up to 30 m were present throughout the period and effectively masked the mean signal, implying that averaging is essential to avoid aliasing. The CTD data were averaged to estimate the mean field during this time frame. ADCP data, also acquired during this period, were also averaged. The mean flow field and dynamic topography implied anticyclonic surface flow with cyclonic flow at 200 m depth, both roughly centered over the axis of the Monterey Submarine Canyon near the mouth of the Bay. Flow at depth appeared to be Canyon "trapped." Surface current speeds were on the order of 10 to 15 cm s^{-1} with somewhat slower speeds at depth of approximately 10 cm s^{-1} . ADCP derived mean flows compared favorably with geostrophic mean flows in all areas except one, the deep outflow region along the northern wall of the Canyon. Calculated standard errors were smaller than the mean signal for both data sets. The smaller standard errors calculated for the ADCP data implied that this method resolved the mean signal better than did the geostrophic calculations. Application of the geostrophic mean field to the open boundary of two layer, primitive equation numerical ocean model yielded flows similar to those described above. The inclusion of linear bottom friction was shown to be particularly important in limiting deep flow to the confines of the Canyon. Wind stress forcing experiments indicated that a strong wind field may influence surface circulation in the Bay. Mean flow fields compared favorably with results of Klinck's (1989) three-level model of geostrophic adjustment of flow over a "narrow" submarine canyon. Interactions between the coastal upwelling geostrophic jet and the Monterey Submarine Canyon is believed to have been a major mechanism responsible for producing the observed method flow.

COMPARISON OF THE DYNAMICS OF A LAND VS. OCEANIC EXPLOSIVE CYCLONE

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B.S., United States Naval Academy, 1979

Master of Science in Meteorology and Oceanography - December 1989

Advisor: W. A. Nuss - Department of Meteorology

Two explosively developing cyclones are analyzed and compared using a similar diagnostic approach. A continental cyclone developed over the U.S. Mid-west during 14-17 November 1988 and was analyzed using NMC Nested Grid model analysis fields and GOES IR imagery. A maritime cyclone rapidly developed over the western North Atlantic Ocean during 03-05 January 1989. The NMC Spectral Model and GOES imagery are employed to describe the development of this storm. Upper-level vorticity, divergence and jet streak placement are examined along with low-level thermal advection, boundary layer heating and static stability for each storm. Results indicate that the land and ocean storms have similar magnitude upper-level divergence associated with 300 mb jet streaks, however, they evolve differently. At low-levels, there are equal contributions from advection and surface heating during rapid development in the ocean case while advection was the primary contribution in the land case. The initial static stability was low for both cyclones, however, the ocean case maintained low static stability and this appears to be a major factor in determining the depth and speed of rapid cyclone development.

ANALYSIS OF AN EDDY-RESOLVING GLOBAL OCEAN MODEL IN THE TROPICAL INIDAN OCEAN

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B.A., Oberlin College

B.S.E.E., Washington University

Master of Science in Meteorology and Physical Oceanography

September 1990

Advisor: A. J. Semtner - Department of Oceanography

This paper examines the Semtner and Chervin global ocean model in the tropical Indian Ocean. The primitive equation, eddy-resolving model covers a domain from 75°S to 65°N at a horizontal resolution of 1/2°, with 20 vertical levels. In a new phase of an ongoing simulation, the wind stress has been changed from annual mean wind forcing to seasonal forcing, using the Hellerman and Rosenstein (1983) wind stress. The model is shown to reproduce the seasonal features of the Indian Ocean circulation. The seasonally-reversing Somali Current is simulated by the model, and includes seasonal undercurrents and a two-gyre system during the southwest monsoon. Westward flow occurs beneath the Southwest Monsoon Current during June and July. The major equatorial currents of the two monsoon regimes are well-represented, including semiannual Wyrski jets and the Equatorial Undercurrent. The seasonal features of the marginally-resolved Leeuwin Current are present in the model. Monthly mass transports have been calculated for the major equatorial currents, as well as the Pacific-Indonesian throughflow, and are consistent with observations. The structure of deep equatorial jets in the model is highly baroclinic; an upward tilt in the jets from west to east accounts for simultaneous westward and upward phase propagation of the zonal velocity. The Haney (1971) method of prescribing surface heat flux, adapted to the Levitus (1982) data base, is analyzed by comparing the model surface heat flux and monthly temperature fields with existing climatologies. The model is shown to exhibit an inherent interannual variability, despite the interannual invariance of the wind stress. The small amount of interannual variability is superimposed on a strong seasonal cycle. Near-surface currents in the model are in good agreement with existing studies of drifting surface buoys.

THE CIRCULATION OF THE CALIFORNIA UNDERCURRENT NEAR MONTEREY

Alan J. Robson - Lieutenant, United States Navy

B.A., University of Washington, 1981

Master of Science in Meteorology and Oceanography - June 1990

Advisor: C. A. Collins - Department of Oceanography

The path of the California Undercurrent off Monterey in May 1989 was studied using hydrographic data. Water mass analysis compared poleward flowing Undercurrent water with southward flowing water of California Current. Isopycnal surfaces and dynamic heights are compared with velocity, water mass properties and bathymetry. The California Undercurrent was observed to flow poleward off Monterey along the continental slope. Water properties that were most strongly associated with water originating from equatorial regions were found at an average depth of 300 m with the core located between 5 and 25 km off the slope. The width of this water mass varied between approximately 10 and 50 km. These waters are deflected offshore by the shelf topography at Pt. Sur, cross the Monterey Canyon, and turn cyclonically following the shelf past Santa Cruz and Pigeon Pt.

BOUNDARY LAYER STRUCTURE OF AN EXPLOSIVE CYCLONE

Glen D. Steeley - Lieutenant, United States Navy

B.A., University of Washington, 1982

Master of Science in Meteorology and Physical Oceanography

March 1990

Advisor: W. A. Nuss - Department of Meteorology

A detailed analysis of the horizontal boundary layer structure of the warm front of an open ocean explosive cyclone in Intensive Observation Period (IOP) 2 of the Experiment on Rapidly Intensifying Cyclones in the Atlantic (ERICA) is conducted. Data for this study consists of aircraft data averaged over one minute supplemented by satellite and drifting buoy observations. Analysis of surface winds and fluxes was done using the Brown-Liu Marine PBL model. Results show a PBL which differs from that found in typical cyclones, with large latent heat fluxes south of the warm front and with relatively weak sensible heat fluxes about the warm front. Boundary layer stratification was stable north of the warm front and unstable south of the warm front. A mechanism for moist frontogenesis is proposed whereby the destabilizing effects of the latent heat flux enhances frictional convergence along the warm front. These fluxes warm and moisten the cyclone's warm sector, enhancing unstable convection along the warm front and thereby enhancing the vertical motion. This enhanced vertical motion would strengthen the geostrophic deformation of the 0_θ gradient and potentially enhance cyclogenesis.

THE NATURE OF THE PROPAGATION OF SEA BREEZE FRONTS IN CENTRAL CALIFORNIA

Joseph A. Yetter, Jr. - Lieutenant, United States Navy

B.S., California State College, PA, 1982

Master of Science in Meteorology and Oceanography

September 1990

Advisor: W. J. Shaw - Department of Meteorology

An examination is made of the nature of propagation of sea breeze fronts in central California. From 15 to 30 September, 1987, the Land/Sea Breeze Experiment (LASBEX) provided a series of meteorological observations including sodar, lidar, rawinsonde, radiosonde and surface observations. Surface observations of opportunity were also available from local marine labs and airports. Using a very simple linear model, the speed and direction of the sea breeze front is investigated. The speed of frontal propagation varied from 1 m/s to 3 m/s. A correlation between the speed of frontal propagation and estimated surface heat flux is observed. The direction of frontal propagation tends to be up valley. Comparison of the frontal propagation vector with stations in the southern portion of Monterey Bay shows that the front is curved on the mesoscale.

**MASTER OF SCIENCE
IN
OCEANOGRAPHY**

EQUATORIAL ENTRAINMENT ZONE SIMULATIONS

Chi-Shao Chen - Lieutenant Commander, Chinese Navy

B.S., Chinese Naval Academy, 1978

Master of Science in Physical Oceanography - June 1990

Advisor: R. W. Garwood - Department of Oceanography

The equatorial entrainment zone model of Garwood et al. (1989) is employed along with data collected by Moum et al. (1984) during the Tropic Heat I Experiment to explain how the dissipation of turbulence is related to surface forcing of wind stress and net heat flux. Four numerical experiments with different atmospheric conditions are conducted with the entrainment zone model. Solar radiation is diurnally repeated, and wind stress is held constant in the first case. The model is forced with linearly varied wind speed in the second case and uses observed winds for the third case. The first three cases demonstrated the effects of wind stress on the dissipation of turbulence. In the final case both observed wind and observed solar radiation were applied to the model to simulate the effect of realistic forcing, allowing a comparison between model-predicted and observed values of dissipation. Numerical solution qualitatively agree with the observations, and the time and depth dependence of the diurnal dissipation cycle are well reproduced by the model.

MODELING A RAIN-INDUCED MIXED LAYER

Hong Beom Hur - Lieutenant, Korean Navy

B.S., Korean Naval Academy, 1984

Master of Science in Oceanography - June 1990

Advisor: J. A. Nystuen - Department of Oceanography

With the development of ocean surface remote sensing, air-sea interaction theory and the theory of underwater sound generation at the ocean surface, the potential calming effect on surface gravity waves by raindrop induced mixing has become important. The rain induced mixed layer was studied with models based on the turbulent kinetic energy budget. A bulk mixed layer model proposed by Garwood was tuned with laboratory experimental data from Green and Houk (J. Fluid Mech., 1979). The turbulent kinetic energy going into subsurface mixing was found to be less than 10% of the total raindrop kinetic energy. The length scale for mixing is proportional to both raindrop size and rain intensity. Furthermore, there is some indication of an initial penetration depth for raindrops. Although the available data was inadequate to complete model development and verification, a prediction for hypothetical situation in the North Pacific is proposed. The diffusion processes are illustrated by solving for the diffusion and dissipation terms of the turbulent kinetic energy equation with a finite difference scheme. New experiments are suggested to allow future model development and testing.

EVALUATION AND IMPROVEMENT OF MINI-RANGER NETWORK IN MONTEREY

BAY FOR OCEANOGRAPHIC PURPOSES

Nicholaos G. Krioneritis - Lieutenant, Hellenic Navy

B.S., Hellenic Naval Academy, 1979

Master of Science in Hydrographic Sciences and

Physical Oceanography

Advisor: K. J. Schnebele - Department of Air-Ocean Sciences

The purpose of this thesis was to evaluate the accuracy of the existing Mini-Ranger network in Monterey Bay and to suggest means by which the network can be improved. This network consists of six stations located around the Bay and installed by the Monterey Bay Aquarium Institute (MBARI) and the Naval Postgraduate School (NPS). In order to undertake this task, data were made available by MBARI which were collected on a cruise made by their vessel "Pt. Lobos". Additional data were gathered on a second cruise by the vessel "Pt. Sur" of the NPS. The data analysis indicated network problems. An effort was made to identify these problems and to compute various correctors. In addition, an equation has been derived which enables use of Mini-Ranger data collected when signal strengths are low. The estimation of the accuracies obtained from the network through the various tests applied, and the conclusions drawn, can be used as a guide to future users of the system.

**SEASONAL VARIABILITY OF THE GEOSTROPHIC VELOCITY AND WATER MASS
STRUCTURE OFF POINT SUR, CALIFORNIA**

Timothy Daniel Tisch - Lieutenant, NOAA

B.S., State University of New York, Maritime College, 1982

Master of Science in Physical Oceanography - September 1990

Advisor: S. R. Ramp - Department of Oceanography

In 1987, the Point Sur Transect (POST) was established by the Department of Oceanography at the Naval Postgraduate School to further the present understanding of long term variability in eastern boundary regions. Of particular interest is time variability of poleward flows, their role in gyre-scale processes, and a more complete understanding of the dynamics involved. The POST extends offshore, normal to bottom topography, along $36^{\circ} 20'N$, to $123^{\circ} 01.7'W$ where it doglegs southwest along the California Cooperative Oceanic Fisheries Investigation (CalCOFI) line 67. Station spacing along the POST is 5-10 km inshore, increasing to 20-40 km offshore. The transect has been occupied 6-8 times per year since 1988, to resolve the flow at seasonal and interannual time scales. Seven of these cruises have been selected for seasonal comparisons of alongshore geostrophic velocities and water mass characteristics. Geostrophic velocities were referenced to the 1000 decibar surface based on coincident PEGASUS observations. Anomalies of spiciness calculated as deviations from an average offshore T-S profile has been used to identify the location and spatial extent of the eastern Pacific water masses. The California Undercurrent (positive spiciness anomaly) was a prominent feature in 6 of the 7 sections analyzed, and was very weak during a period of uncommonly strong equatorward wind stress. The position of the core varied from 12 to 42 km from shore while its strength varied from 10 to 35 cm s⁻¹, with the maximum flow occurring in winter. The vertical extent of the Undercurrent covered a region of the continental slope from 70 to 460 m throughout these seven cruises. The nature of the alongshore geostrophic velocities and the location and spatial extent of the undercurrent appear to strongly related to specific wind events, both local and remote. Remote wind forcing from the south was believed to cause anomalous, strong poleward flow throughout the entire water column during a period of local equatorward wind stress, while the intrusion of warm, salty water was believed to cause the deep penetration (to 700 m) of the California Current in winter. Observations presented throughout this study appear to have revealed interannual rather than seasonal variability. This is not surprising since only seven cruises were selected for study whereas earlier studies utilized many years of data collected along the CalCOFI sampling grid to determine the seasonal means. This study excelled over the continental shelf and slope where the station spacing of the POST is considerably closer than the CalCOFI scheme, which allowed for the study of narrow coastal jets not well resolved by the CalCOFI grid.

**SUBMESOSCALE STRUCTURE OF THE CALIFORNIA CURRENT NEAR
SAN CLEMENTE ISLAND**

Ching-Mao Tsai - Commander, Taiwan, R.O.C. Navy

B.S., Chung-Cheng Institute of Technology, Taiwan, R.O.C., 1976

Master of Science in Physical Oceanography - June 1990

Advisor: P.-C. Chu - Department of Oceanography

The purpose of the San Clemente Basin Experiment (SCBE) was to survey the upper ocean currents and temperature in a region southwest of San Clemente Island (SCI). To accomplish this, two cruises were made in this area during which currents were measured by using a shipboard mounted Acoustic Doppler Current profiler (ADCP), and temperature was measured during the second cruise by deploying Expendable Bathythermographs (XBT). The first cruise took place during 17-21 July 1989 and the second one during 2-6 September 1989. Data indicate a variety of features. Two different flow patterns were observed. Strong poleward alongshore flow (about 40 cm/s) occurred 5-15 km west of SCI and small scale eddies were seen further offshore, i.e., farther than 15 km west of SCI. The alongshore flow intensified poleward, reaching 300 m depth. The small scale eddies have a length scale of about 10 km and are believed to be associated with larger scale horizontal shear due to the California current

**MASTER OF SCIENCE
IN
OPERATIONS RESEARCH**

**THE DEVELOPMENT OF A NAVAL BATTLE MODEL AND ITS VALIDATION USING
HISTORICAL DATA**

Thomas Reagan Beall - Lieutenant, United States Navy

B.A., University of Michigan, 1983

Master of Science in Operations Research - March 1990

Advisor: W. P. Hughes - Department of Operations Research

This thesis describes the development and validation of a naval battle model which incorporates a tactical theory by Captain Wayne P. Hughes, Jr. Opposing forces are portrayed as aggregations of the staying power and combat power of their individual platforms. Attrition is modeled as a force-on-force process and is expressed in terms of the degradation of each force's combat power and staying power throughout the engagement. User variation of model inputs concerning the timing, direction and strength of each force's fire permits analysis of the impact of scouting effectiveness and C^2 on battle dynamics. Data from fourteen historical naval battles were gathered to compute model input parameters for the opposing forces and their interactions. The model's prediction of the outcome is compared with each battle's actual outcome. The conclusion drawn from this analysis is that the model is a fair representation of reality. The model's potential for practical application is explored by using it to analyze the tactical options of the U.S. commander at the World War II Battle of Savo Island. Model results clearly indicate the weaknesses in U.S. tactics in this battle and suggest alternative tactics which afforded a better chance of success.

**APPROXIMATE INTERVAL ESTIMATION METHODS FOR THE RELIABILITY OF
SYSTEMS USING DISCRETE COMPONENT DATA**

Edmundo F. Bellini - Lieutenant, United States Navy

B.S., United States Air Force Academy, 1976

Master of Science in Operations Research - September 1990

Advisor: W. M. Woods - Department of Operations Research

Three lower confidence interval estimation procedures for system reliability of coherent systems with cyclic components are developed and their accuracy evaluated by Monte Carlo methods. Each method uses estimates of the ratios of component unreliabilities and the Poisson approximation to the binomial distribution to obtain the equation for the lower confidence limit. This is an extension of a method previously reported in the literature which has been shown to be fairly robust. The procedures developed here can be combined with similar procedures already developed for systems with continuous components. The combined procedure may yield a reasonably accurate lower confidence interval procedure for the reliability of coherent systems with mixtures of continuous and cyclic components.

**THE EFFECT OF A U.S. NAVY REDUCTION IN FORCES ON THE CAREER
PATH OF SURFACE WARFARE OFFICERS PROGRESSING TO COMMAND AT SEA**

Lawrence G. Bertolino - Lieutenant, United States Navy

B.A., Tulane University of Louisiana, 1983

Master of Science in Operations Research - September 1990

Advisor: P. R. Milch - Department of Operations Research

This thesis analyzes the effects of planned U.S. Navy reduction in forces on the career path of Surface Warfare Officers progressing towards Command at Sea. FORECASTER, a Markovian model for forecasting naval officer distributions, was utilized to conduct steady state and transient analyses of current and planned billet data for FY 1990 - FY1995. The results of these analyses indicated that a larger portion of officers will be serving in follow-on division officer tours, single (longer) department head tours, and in second (split) tour department head tours. Additionally, both Executive Officer and Commander Command Opportunity will decrease as billet reductions and redistributions are enacted.

**PROBABILISTIC OBSERVATIONS ON ANTISUBMARINE WARFARE TACTICAL
DECISION AID (ASWTDA)**

Bruce R. Bjorklund

Master of Science in Operations Research - March 1990

Advisor: A. R. Washburn - Department of Operations Research

The goal of this thesis is to examine the methodology used in the Antisubmarine Warfare Tactical Decision Aid (ASWTDA) in development by Sonalysts, Incorporated of Waterford, Connecticut under Navy contract. ASWTDA is a Computer Assisted Search (CAS) program which is designed as a tool to assist platform, unit or force commanders afloat and ashore in making tactical ASW decisions. First, a Classical Computer Assisted Search program is described as a basis of comparison for the methodology employed in ASWTDA. Then, the operations as performed in ASWTDA are described, followed by a probabilistic analysis. In the analysis sections, probabilistic support for the applied methodology is provided where applicable, and conceptual problems and possible solutions are cited where appropriate.

**AVAILABILITY OF AIRCRAFT SUBJECT TO IMPERFECT
PREVENTIVE MAINTENANCE**

**Michael Joseph Bond - Lieutenant Commander, United States Navy
B.S., University of Mississippi, 1979**

Master of Science in Operations Research - September 1990

Advisor: M. P. Bailey - Department of Operations Research

This thesis studies the impact that imperfect preventive maintenance has on the availability of aircraft and, as a result, the decrease in effectiveness. We further consider the practicality of using an imperfect preventive maintenance model for determining preventive maintenance schedules. Simulation was used to recreate the operational environment in order to study the effects that levels of imperfect preventive maintenance have on the aircraft effectiveness during execution of an actual fleet tactic.

**A COST ESTIMATION MODEL FOR THE SEA LAUNCH AND RECOVERY SPACE
TRANSPORTATION SYSTEM**

Layne Renee Boone - Lieutenant, United States Navy

B.A., Fisk University, 1970

M.Ed., University of Virginia, 1976

Master of Science in Operations Research - September 1990

**Co-Advisors: M. Melich - Department of Physics & D. C. Boger -
Department of Administrative Science**

The Sea Launch and Recovery Space Transportation System is envisioned as a means of achieving not only more effective but lower cost space operation. The development of a cost estimation model is important in determining the feasibility of this system. The purpose of this thesis is to provide a cornerstone for the design of such a cost estimation model. The model presented here can be used to compute the minimum cost per mission as a function of selected design variables. The particular variables considered are the type or types of materials used in the fuel tanks of the rocket and characteristics of the fuel logistics, such as port locations. Thus, it is a tool to be utilized by the system designers in judging the value of particular rocket fuel tank designs. It can also aid in the selection of the operational port for the system. Implementation issues are discussed and evaluated. Future enhancements to the model are also discussed.

**AN INTERACTIVE LINEAR PROGRAMMING APPROACH TO SOLVING LARGE
CUMULATIVE SEARCH-EVASION GAMES**

Brian P. Bothwell - Lieutenant, United States Navy

B.S., University of Notre Dame, 1983

Master of Science in Operations Research - March 1990

Advisor: A. R. Washburn - Department of Operations Research

Cumulative search-evasion games (CSEGs) involve two players, a searcher and an evader, who move among some finite set of cells. Neither player is aware of the other player's position during any stage of the game. When the payoff for the game is assumed to be the number of times the searcher and evader occupy the same cell, Eagle and Washburn proposed two solution techniques: one by fictitious play and the other by solving equivalent linear programming formulations. However, both have proved to be time consuming even for moderately sized problems. This thesis considers two alternate linear programming formulations for CSEGs. Since both contain a large number of variables and constraints, the linear programming problems are initially solved with many of the constraints removed. If the solution to this relaxed problem is not a feasible optimal solution, additional constraints are added and the problem is solved again. This process continues until a feasible optimal solution is found. The results from a numerical experimentation with various solution techniques are also presented.

OPERATIONAL IMPLICATIONS OF 3 X 8 FIELD ARTILLERY BATTALIONS

C. Craig Buzan - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Operations Research - September 1990

Advisor: D. Barr - Department of Mathematics

A comparison is performed of battlefield effects of 3x8 field artillery cannon battalions using two different methods of employing battery fires. Battles conducted at the National Training Center are used as a basis for developing scenarios for analysis. The NTC Livefire OPFOR is replicated in Janus, and artillery missions from actual battles are fired against it. The two methods of artillery employment are platoon fires and battery fires. A statistical analysis is performed on the results, and the operational implications are presented. The findings indicate that the method of employing batteries, a unified battery versus independent platoons, does influence the number of kills obtained. But which method yields the best effects is highly dependent upon numerous scenario related factors.

THE FUNDAMENTALS OF SALVO WARFARE

Jeffrey Richard Cares - Lieutenant, United States Navy

B.A., Vanderbilt University, 1984

Master of Science in Operations Research - March 1990

Advisor: W. P. Hughes - Department of Operations Research

This thesis presents a detailed study of the fundamentals of modern naval surface missile combat and, through the vehicles of combat modeling, simulations, and quantitative analysis, describes a method of evaluating tactics. It establishes three basic laws of naval combat, tests the theory that undergirds the laws against a data set, and provides a thorough analysis of the results.

ECONOMIC ANALYSIS OF ALTERNATIVES FOR PC UPGRADE OF OR DEPARTMENT LABORATORY

Lung-Shan Chen - Major, Republic of China on Taiwan Army

B.S., Defence Management Institute, 1980

Master of Science in Operations Research - September 1990

Advisor: T. E. Halwachs - Department of Operations Research

The Operations Research Department at the NPS plans to upgrade the hardware of the Personal Computer (PC) laboratory. The objective of this thesis is to analyze the potential upgrade paths dependent upon hardware availability, , software compatibility, maintenance and initial cost. The alternatives are: (a) to upgrade the existing Zenith with a 80386 (CPU), (b) to buy the UNISYS desktop III system or (c) to purchase the DELL SYSTEM-310. The study utilizes the economic cost/benefit approach to examine the alternatives and to develop recommendations. The principles of economic analysis are reviewed. The results of survey of user's opinion are analyzed to establish the requirements for upgrade. The result of economic analysis shows the UNISYS system to be the cheapest and most system-effective. The price of each unit is an undiscounted \$2,176 or discounted \$1,994 for five years of economic life and is within the budget available. The sensitivity analysis reveals (a) by break-even analysis, the economic life parameter is insensitive, (b) the cost reduction parameter is also insensitive, and (c) the discount rate is also insensitive. Therefore the recommendation is that the UNISYS system be chosen.

AN EXAMINATION OF THE RELATIONSHIP BETWEEN ATOMIC ABSORPTION READINGS AND ATOMIC EMISSION READINGS IN THE JOINT OIL ANALYSIS PROGRAM

Moon Soo Choi - Major, Republic of Korea Army

B.S., Korea Military Academy, 1980

Master of Science in Operations Research - March 1990

Advisor: H. J. Larson - Department of Operations Research

The purpose of this thesis is to examine the relationship between atomic absorption spectrometer readings and atomic emission spectrometer readings. Orthogonal regression techniques are employed to analyze correlation program data from the Joint Oil Analysis Program. Actual used-oil sample analyses from the B003 data bank are employed to see if the estimated relationships from the correlation program data prove usable for real used-oil samples.

MEASURING AND ANALYZING COGNITIVE SKILL AT THE PLATOON LEVEL

Michael G. Clark - Captain, United States Army

B.S., United States Military Academy, West Point, NY

Master of Science in Operations Research - March 1990

Advisor: S. Parry - Department of Operations Research

Increasing budget restrictions require the Army to show that the policy of recruiting high quality people is paying dividends. The question is whether or not money being spent on better recruits is justified on the basis of combat efficiency. The measure of quality used in this research is the Armed Forces Qualification Test (AFQT) score. The higher the AFQT score the better the recruit. Previous studies have found a strong correlation between mental ability and hands-on performance. The focus of this research is on the command and control or cognitive performance of the platoon leader. The method of investigating the relationship between cognitive skill and mental ability is to develop a tactical paper and pencil test and administer the test to a group of Non-Commissioned Officers from Fort Ord, California. The test is given once at the beginning of the Basic Non-Commissioned Officer Course of instruction and once at the end of the course. The three objectives of this research are to determine which variables most influence decision making abilities, determine if a significant difference in decision making ability exists between mental categories and determine if training can make up for differences in decision making ability. The results of the research show that AFQT scores are highly correlated with decision making ability, statistically significant differences exist between the decision making abilities of higher mental categories (CAT I and II) and lower mental categories (CAT IIIB and IV) and training does help make up for mental category differences. Overall, mental category I leaders perform about 13% better than mental category IV leaders. In addition, training is able to raise the average score of lower mental category leaders by 8%.

**LOWER CONFIDENCE INTERVAL BOUNDS FOR COHERENT SYSTEMS
WITH CYCLIC COMPONENTS**

Valerie A. Covington - Lieutenant, United States Navy

B.A., University of South Florida, 1975

M.Ed., West Georgia College, 1979

Master of Science in Operations Research - September 1990

Advisor: W. M. Woods - Department of Operations Research

Three lower confidence interval estimation procedures for system reliability of coherent systems with cyclic components are developed and their accuracy measured using Monte Carlo techniques. The procedures use either the Poisson approximation to the Binomial distribution, the lower Binomial confidence limit procedure, or a modified procedure using the Poisson approximation to the Binomial distribution to obtain an equation for the lower confidence limit. The accuracy of the interval estimators were evaluated using standard computer simulation methods for series, parallel, series-parallel, and Wheatstone Bridge systems. The method determined to be most accurate can be combined with similar procedures for components that have continuous failure times and applied to yield a lower confidence interval procedure for the reliability of coherent systems with cyclic and continuously operating components.

**AN INTEGER PROGRAMMING MODEL FOR NAVY'S MARITIME PATROL
AVIATION FLEET**

Robert W. Drash - Lieutenant Commander, United States Navy

B.A., University of Virginia

Master of Science in Operations Research - September 1990

Advisor: R. K. Wood - Department of Operations Research

This thesis details an integer programming model to aid in the modernization of the Navy's Maritime Patrol Aviation fleet. Over a user specified time horizon, the model provides a schedule for when to retire, perform avionics upgrades, or transfer current inventory aircraft from the USN to the USNR. Additionally, the model determines when to open a new aircraft production line and the number of aircraft to procure each year. The model optimizes the modernization schedule while taking into consideration required inventory, minimum required percentage of aircraft containing modern avionics, maximum desired mean aircraft age, budgetary limitations, and production line restrictions. The model minimizes the procurement, operating, and maintenance costs using the X-System solver.

**ESTIMATING COMMUTE DISTANCES OF U.S. ARMY RESERVISTS BY
REGIONAL AND UNIT CHARACTERISTICS**

Steven E. Galing - Captain, United States Army

B.S., United States Military Academy, 1980

M.B.A., Western New England College, 1988

Master of Science in Operations Research - September 1990

Advisor: L. Johnson - Department of Operations Research

This thesis develops a multiple regression model using regional and unit characteristics to estimate commuting distances of U.S. Army Reservists. The data were obtained from a 1988 file established by the Defense Manpower Data Center containing locational and biodemographic information on 238,174 enlisted reservists. A random sample of 91 reserve centers was selected for the analysis. The logistic and normal distributions were evaluated as possible candidates for fitting the commuting distance distribution. It was found that a power transformation of the fractional distance traveled fit both distributions quite well. Parameters for the two distributions are obtained through a method of maximum likelihood estimation. Finally, a multiple regression equation is used to estimate the parameters of the commute distance distribution as a function of reserve center and market characteristics. The results of the multiple regression equation provide the U.S. Army Recruiting Command with some important variables necessary to predict commuting distances.

THE EXPLORATION OF AN ALTERNATIVE TO ACCEPTANCE SAMPLING

Craig A. Hammons - Lieutenant, United States Navy

B.S., Oklahoma State University, 1984

Master of Science in Operations Research - June 1990

Advisor: G. F. Lindsay - Department of Operations Research

This thesis considers the problem of evaluating a producer's program in statistical process control, from the standpoint of the consumer. A model is postulated reflecting the variability in proportion nonconforming of a process and the characteristics of the final control chart in the process. From this steady-state solution to a Markov chain is used to find the output proportion nonconforming of the process.

AN INVESTIGATION OF AN ALTERNATIVE TO ACCEPTANCE SAMPLING THROUGH A MARKOV CHAIN ANALYSIS OF A MANUFACTURING PROCESS QUALITY CONTROL PROGRAM

Daniel F. Harrington - Captain, United States Marine Corps

B.S., United States Naval Academy, 1981

Master of Science in Operations Research - September 1990

Advisor: G. F. Lindsay - Department of Operations Research

In this thesis, we investigate the examination of a manufacturer's in-house quality program as an alternative to acceptance sampling. The manufacturing process addressed is one which consists of a production section, capable of producing items at one of two levels of fraction nonconforming, and a quality control section which consists of a single p-chart. The quality levels that result from this manufacturing process are represented using a Markov chain. A method of estimating the fraction of nonconforming items produced by the process is developed. Confidence intervals on this fraction nonconforming are obtained and these values considered for use in an alternative acceptance criteria for lots. When the upper confidence limit on the lot fraction nonconforming does not exceed the Acceptable Quality Level, there is considerable confidence that lots randomly selected from the manufacturing process will be acceptable without acceptance sampling.

A MODERN NAVAL COMBAT MODEL

Epaminondas A. Hatzopoulos - Lieutenant, Hellenic Navy

B.S., Hellenic Naval Academy, 1978

Master of Science in Operations Research - September 1990

Advisor: M. D. Weir - Department of Mathematics

This report develops a modern naval combat model. It deals with naval surface missile combat and models the attrition as a force-on-force process described in discrete time steps, or "salvos." The degradation of each force is expressed in terms of remaining staying power and combat power in both opponents. It is based on LT. Beall's model, but since it deals with missile warfare it incorporates the defensive ability of each force. Furthermore, as a central feature, the model incorporates several human factors that affect the outcome of a naval battle: specifically scouting and alertness effectiveness, leadership, morale, and training.

**AN APPLICATION OF SURVIVAL ANALYSIS METHODS TO THE STUDY
OF MARINE ENLISTED ATTRITION**

**Eric A. Hawes - Captain, United States Marine Corps
B.I.E., Georgia Institute of Technology, 1984
Master of Science in Operations Research - March 1990
Advisor: R. R. Read - Department of Operations Research**

This thesis is an application of survival analysis methods to study first term enlisted attrition from the Marine Corps. The data comprise over 99 percent of all enlisted accessions into the Marine Corps between 1 October 1983, and 31 August 1988. A large percentage of the observations are censored, thus motivating the use of survival analysis techniques. The enlistees are categorized by three covariates: education credential, Armed Forces Mental Group (AFMG), and presence/non-presence of a moral waiver. The attrition behavior of the enlistees is then examined to identify which covariate classifications are associated with premature attrition. The majority of the findings concerning the effects of the covariates on attrition are consistent with published results from previous military attrition studies. Two findings of the thesis, though, are perhaps new. First, the attrition behavior of alternate high school credential holders varied significantly according to credential type. Second, the relationship between aptitude and attrition behavior appears to have weakened in recent years. The thesis also provides an opportunity to evaluate the uncommon practice of using survival analysis methods to examine military attrition. The results are promising as the survival analysis methods prove to be both accurate and efficient. Graphical plots of survivor function estimates provide an easily understood illustration of attrition behavior. The use of log-linear regression to model military attrition shows potential as a desk-top tool for conducting informal analyses.

**AN AID FOR FLIGHT SQUADRON SCHEDULING
Tetsuichi Kawakami - Lieutenant Commander, Japan Maritime
Self-Defense Force**

**B.S., Nagoya University, JAPAN, 1979
Master of Science in Operations Research - March 1990
Advisor: R. K. Wood - Department of Operations Research**

An integer program approach is taken to schedule daily training flights in a Japanese operational flight squadron and an American flight training squadron. Two related models for the Japan Maritime Self-Defense Force (JMSDF) are considered for pilots just out of the training pipeline and for fully qualified pilots. Explicit measures of effectiveness that update pilot currency are used, while instructor and aircraft availabilities create resource restrictions. The models are implemented in the GAMS language and solved with the ZOOM solver, using simulated data which include up to 19 pilots. A typical model with 477 constraints and 129 variables is solved in 23.5 seconds on an IBM 3033AP.

**ANALYSIS OF DATA COMMUNICATION NETWORK'S PERFORMANCE UNDER
VARYING RETRANSMISSION DISCIPLINES**

**John R. Kirwan, Jr. - Commander, United States Navy
B.S., U.S., Naval Academy, 1973
Master of Science in Operations Research - September 1990
Advisor: D. P. Gaver - Department of Operations Research**

A stochastic simulation model is developed, using the SLAM II simulation language, to study the dynamics and performance of a small data communication network. The simulation program models pertinent aspects of Defense Data Network (DDN) protocols. The effect of changes in node-to-node and host-to-host retransmission timeout intervals upon expected response time is studied using the model.

**MULTIPAMETER FORECASTING TECHNIQUES FOR THE MARINE CORPS
OFFICER RATE GENERATOR**

**Charles J. Mehalic - Major, United States Marine Corps
B.S., United States Naval Academy, 1976
M.S., University of Southern California, 1981**

**Master of Science in Operations Research - September 1990
Advisor: R. R. Read - Department of Operations Research**

This thesis expands upon previous work in applying aggregation and shrinkage techniques to Marine Corps officer attrition rate estimators. Until now, estimation was based upon available annual data, failing to consider within year seasonality as a factor. Exploring modern short-term forecasting techniques which include a seasonal factor, this research applies seasonality on a quarterly basis with conversion flexibility to any desired cycle. We introduce and compare two models: the Harrison-Stevens Multli-State Bayesian model and the Winters Three-Parameter Exponential Smoothing model. Both methods provide capable forecasting and demonstrate the necessity of including seasonality. The Harrison-Stevens approach has the advantage of providing a posterior distribution rather than a point estimate, and proves to be the superior model when forecasting beyond one period.

SCHEDULING AND ROUTING TACTICAL AERIAL RECONNAISSANCE VEHICLES

**Huey Douglas Moser, Jr. - Captain, United States Marine Corps
B.S., North Carolina State University, 1980**

**Master of Science in Operations Research - September 1990
Advisor: R. E. Rosenthal - Department of Operations Research**

In this thesis we study the Marine Corps Tactical Aerial Reconnaissance Vehicle routing and scheduling problem. The present method of routing and scheduling is presented, along with possible implications for routing and scheduling when future expansion of vehicle assets becomes available. A review of current literature is given, and comparisons are drawn between our problem and recent work. A model for the problem, which we call the *Multi-Player Orienteering Problem with Time-Windows*, is developed. We present both an optimization based solution and a heuristic solution for the problem. Computational results are shown for each, along with our reasons for selecting the heuristic solution as the best of the two solutions approaches attempted.

ANALYSIS OF ANTI-HELICOPTER MINE EMPLOYMENT USING A MARKOV CHAIN FORMULATION

**Rodger A. Oetjen - Major, United States Army
B.S., United States Military Academy, 1978
Master of Science in Operations Research - June 1990
Advisors: S. H. Parry and Major J. C. Hoffman -
Department of Operations Research**

This thesis develops a robust analytical simulation model to examine the performance characteristics of three types of anti-helicopter mines; proposed future weapon systems for which is little known. The anti-helicopter mine system dynamics are represented by a sixteen state Markov chain formulation containing transient and absorbing states run in concert with a Monte Carlo simulation process. The primary measures of effectiveness (MOEs) used for comparison of relative combat effectiveness are the average number of occurrences of enemy helicopter kill, mine/missile failure and mine system destruction per engagement. The Beta distribution is used in an APL simulation model with a uniform random number generator to dynamically represent actual transition probabilities which are a function of the characteristics of threat capabilities and tactics employed, number of enemy targets in the area and the quantity of missiles previously launched. Sensitivity analysis is performed in order to investigate weapon system performance under various threat, target and missile firing scenarios.

A COMPUTER SIMULATION OF A MAD BUOY FIELD

Phillip C. Pardue - Lieutenant, United States Navy

B.S., Vanderbilt University, 1983

Master of Science in Operations Research - March 1990

Advisor: R. N. Forrest - Department of Operations Research

The thesis describes an analysis of a Magnetic Anomaly Detection (MAD) buoy field. The analysis was based on estimates of the probability a submarine would be detected during an encounter with a MAD buoy. The estimates were determined by using a simulation of both a crosscorrelation detection system and a square law detection system. Using these estimates, a random search model was used to determine a lower bound on the search effectiveness of a MAD buoy field. In doing this, the effects of false alarm rate, sweep width, noise level, buoy depth, and target displacement were analyzed. A discussion of the simulation inputs, as well as a program listing are included in the thesis in order to facilitate future use of the simulation.

ANALYSIS OF AIR LAND COMBAT TACTICS USING JANUS(T) SYSTEM

Hun Keun Park - Captain, Republic of Korean Army

B.S., Korea Military Academy, 1984

Master of Science in Operations Research - March 1990

Advisor: S. H. Parry - Department of Operations Research

The comparison of fighting tactics in a high-resolution model from the JANUS(T) system is the primary purpose for this thesis. The scenario is fought between the South Korean Army Battalion Task force (called Blue) against a North Korean Mechanized Battalion (Red). Two courses of action for defense are analyzed in order to determine whether a static or dynamic tactic is better for the Blue force in a sector during the first thirty minutes of an invasion into South Korea. Attrition rates, firepower scores, and the number of survivors are needed to compute the force ratio, which is primary measure of effectiveness. At the end of the battle, the course of action for the static defense has the largest force ratio and is the better tactic. The data that are generated from the JANUS(T) model form the fundamental basis for the comparison of methods that calculate force ratios. The data from the Janus(T) model are important because they are propagated from a database of the actual terrain of Korea and of the characteristics of hostile and allied weapons. The JANUS(T) output shows casualties of the four weapon types for both forces during a simulated time period. The sequence of weapon casualties form a time history or time series. The maximum likelihood estimates (MLE) for time series of the casualties is derived by the Combat Analysis Model (COMAN). The attrition rate is then used by the potential-antipotential (PAP) system and the Lanchester simulation. A recent enhancement to the JANUS(T) system includes the capability for the user to structure a combat scenario and allow it to run multiple times in an automatic mode, where the randomness of each replication is a result of Monte Carlo processes on random variables (i.e., detections, hits and kills) which will give different results with each simulation. Assuming independence, the COMAN MLE is used on the combined time-series of ten replications. Embedded into the COMAN MLE attrition rates are the other battlefield factors. The attrition rates include much more than the probability of kill (PK) values. The attrition rate that was produced is a composite of the interaction of every system, not just the firepower. The Eigenvalue matrix in the thesis encompasses the relevant databases inherent to the JANUS(T) system. Consequently, the value vector is as good as the portrayal of battle which is produced by the JANUS(T) system.

**METHODOLOGY AND ANALYSIS OF GROUND MANEUVER SYNCHRONIZATION AT
THE NATIONAL TRAINING CENTER**

Joel R. Parker - Captain, United States Army

B.S., University of Kansas, 1981

Master of Science in Operations Research - September 1990

Advisor: R. R. Read - Department of Operations Research

This thesis analyzes deliberate attack missions conducted at the U.S. Army National Training Center and checks for relationships between ground force synchronization at the mission critical point and a measure of effectiveness. This analysis should facilitate the development of similar or more in-depth studies of combined arms operations in desert warfare. Procedures are developed to quantify the core offensive doctrinal concepts addressed in U.S. Army Field Manual 100-5: Operations. The thesis also addresses current critical shortfalls in the National Training Center data collection process and identifies agencies which can potentially render corrective support.

AN APPROACH TO AN ASSIGNMENT PROBLEM WITH HIERARCHICAL OBJECTIVES

Michael S. Paul - Lieutenant, United States Navy

B.S.E., University of Michigan, 1982

Master of Science in Operations Research - March 1990

Advisor: S. Lawphongpanich - Department of Operations Research

At the Naval Military Personnel Command (NMPC), multiple objectives must be considered in assigning personnel to billets. For the assignment of Naval Officers, these objectives in decreasing order of importance are to satisfy the needs of the Navy, to enhance the careers of officers, to fulfill the desires of officers, and to minimize cost. To assist in this complicated task, a procedure which considers these four objectives in their order of importance is proposed. Each time, a standard assignment problem is solved by optimizing one objective with the additional constraint that values of the other more important objectives remain above specified levels. A modification of a multiobjective programming technique, the Noninferior Set Estimation method, is used to guarantee integer solutions to an assignment problem with these additional constraints. An application of the procedure to an actual Navy officer assignment problem indicates its potential as a decision aid to NMPC officers and other decision makers.

**AN ANALYSIS OF THE EFFECT OF FREQUENCY OF TASK PERFORMANCE
ON JOB PERFORMANCE MEASUREMENT**

Rick L. Reece - Captain, United States Marine Corps

B.S., United States Naval Academy, 1978

Master of Science in Operations Research - March 1990

Advisor: L. D. Johnson - Department of Operations Research

This thesis explores the effect of frequency of performance on the Congressionally mandated Job Performance Measurement, specifically the Marine Corps' portion of the study. The initial portion of the project involved the hands-on performance testing of the infantry specialties. The purpose of this thesis is to validate the use of the general technical (GT) composite of the ASVAB test as a predictor of performance in the infantry specialty and to provide recommendations to revise training priorities. Our approach in analyzing the problem included the following: (i) computing the correlation between aptitude and performance, then investigating any degrading or moderating effect that frequency might have on this relationship, (ii) an investigation into the performance of high aptitude personnel versus low aptitude personnel across frequency categories, and (iii) the relative effect of frequency on the maintenance of proficiency in each task. We have validated the use of the GT composite as an effective predictor for hands on performance by performing analysis of variance. An interesting result was the determination that frequency is the major predictor for performance based tasks requiring continual practice for the maintenance of skill levels, while recency is the major factor in predicting tasks that are more knowledge based and require the recall of detailed procedures.

**A COMPARATIVE ANALYSIS OF THE TACTICAL ROUTES SELECTED BY THE CAMMS/
SHAW DECISION AID WITH ROUTES SELECTED BY ACTIVE DUTY OFFICERS**

John S. Regan - Captain, United States Army

B.S., United States Military Academy, 1980

Master of Science in Operations Research - September 1990

Advisor: S. H. Parry - Department of Operations Research

This thesis is an evaluation of the performance of a tactical route decision aid model that was developed by CPT Charles Shaw in his 1989 Master's thesis. The decision aid was developed as a module inside the Condensed Army Mobility Management Model (CAMMS). The decision aid selects tactical routes based upon a complex methodology which considers a number of variables in the tactical situation and the time available. The Janus(A) high resolution combat model was chosen to compare the routes selected by the decision aid against routes selected by active duty officers in two different areas of operation. A measure of effectiveness was selected based on the casualty figures generated by the Janus(A) model. When compared against the officer routes using the MOE, decision aid routes were more effective in one of the two areas of operation. Janus(A) was also used to determine if routes the decision aid deemed as "better" were more effective as measured by the MOE. The study found that some of the "better" routes were actually less effective in Janus(A). The study concludes that the model needs some refinement.

**A CONSTRAINT BRANCH-AND-BOUND METHOD FOR SET
PARTITIONING PROBLEMS**

Moo Bong Ryoo - Captain, Republic of Korea Army

B.S., Korea Military Academy, 1986

Master of Science in Operations Research - March 1990

Advisor: R. K. Wood - Department of Operations Research

This thesis compares the efficiency of a constraint branch-and-bound method against the conventional variable branch-and-bound method in solving set partitioning problems. Because of the difficulties encountered in writing the constraint branch-and-bound subroutine, it was necessary to solve each subproblem encountered from scratch. This is in contrast to the variable branching code which, when solving closely related subproblems, essentially starts from an advanced starting solution. Even using an inefficient implementation, the constraint branch-and-bound method appears to be significantly more efficient than the conventional variable branch-and-bound method. It saves, on average, 30.0% in CPU time over the variable branch-and-bound method when tested on a set of small test problems. On average, constraint branch and bound produces 59.3% fewer nodes in its enumeration trees than does variable branch and bound, and the trees encountered are shallower and better balanced.

**A COMPARATIVE ANALYSIS OF U.S. ARMY AIR DEFENSE ARTILLERY
STRATEGIES USING THE JOINT THEATER LEVEL SIMULATION MODEL**

David M. Savage - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Operations Research - September 1990

Advisor: S. H. Parry - Department of Operations Analysis

This thesis seeks to determine if U.S. Army Air Defense Artillery (ADA) units positioned in a belt defense perform better than the point defense that the U.S. Army currently uses. It does this through a comparison of three ADA defense strategies: 1. Forward Concentration (belt defense) 2. Balanced Concentration (point defense) 3. Rear Area Concentration (point defense). The Joint Theater Level Simulation, a computer combat simulation model, is used as a tool for analysis to compare the three strategies in a Fulda Gap scenario against a variety of Soviet attack options. The JTLS model is used because of its ability to simulate large forces and also to demonstrate the value of JTLS as an analytical tool, in addition to a training and evaluation tool. Using the following measures of effectiveness: Soviet airplanes shot down by US ADA, percentage of successful Soviet bombing missions, and number of US ground-targets destroyed, the forward concentration defense proves to have a significant advantage over the other two strategies, regardless of the weighting of the measures of effectiveness.

MEASURE OF EFFECTIVENESS FOR AMPHIBIOUS SHIP LOADING

Joseph M. Schneider - Lieutenant Commander, United States Navy

S.B., Massachusetts Institute of Technology, 1977

Master of Science in Operations Research - March 1990

Advisor: G. H. Bradley - Department of Operations Research

A critical factor in the success of an amphibious operation is how well the load plan supports the landing plan. The current manual system for ship loading planning is time consuming and subject to error. A computer system currently under development by a contractor will decrease planning time and reduce mistakes by automating many details of the planning process. A method to assess the quality of load plans and make comparisons among them is also essential to improved planning. The scoring algorithm developed in this paper implements a measure of effectiveness (MOE) to make these comparisons by scoring a load plan's ability to support the landing plan. The algorithm provides the ability to differentiate qualitatively among loads by computing penalty scores for the critical areas of equipment left behind, compartment location, and compartment access. The trade-off of lightly loading the ship for flexibility versus leaving critical cargo behind is implicitly considered. Raw and normalized scores in each area and a total score are provided to the user. The MOE produced by this scoring algorithm is cost effective, easy to implement, easy to use and, if fully developed and adopted, will lead to improved loading of amphibious ships.

A THEORY AND MODEL FOR THE PLANNING OF LAND COMBAT

Thomas Joseph Schwartz - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Operations Research - September 1990

**Advisors: W. J. Caldwell & L. D. Johnson - Department of
Operations Research**

Planning land combat operations requires a method of evaluation to determine the strengths and weaknesses of the various possible courses of action. The principal means of evaluating these courses of action is wargaming. Some research indicates that planning efforts lack a coherent set of wargaming rules and principles that are widely accepted and understood by military professionals. This thesis develops a theory of combat for use by military professionals in the planning of land combat. The theory provides a method for evaluating alternative courses of action at the brigade through corps level that can be easily applied. The theory is based on the analysis and modeling of categorical data from the U.S. Army Concepts Analysis Agency's Benchmark database. The database includes 260 combined arms battles from the period 1937 through 1982. Longlinear models provide maximum likelihood estimates of the probability of an attack's success. The principle of falsification is explained and used to validate the theory using the historical data. Applications of the theory and model to the planning of land combat are discussed and areas for further research are outlined.

THE NAVAL AIRSHIP AND THE REVOLUTION AT SEA
James Richard Shelby - Lieutenant Commander, United States Navy Reserves
B.S., Memphis State University, 1975
Master of Science in Operations Research - September 1990
Advisor: W. P. Hughes - Department of Operations Research

A system is proposed to combine an airship based fire control system (using off-the-shelf hardware) with surface ship launched SAMs (NTU/SM-2 ER) to provide OTH wide area ASCM defense for convoys and surface battle groups currently without organic airborne AAW assets. The effectiveness of surface ship AAW area defense is compared, both with and without the airship system, against low-flying ASCMs. The proposed airship system is based on combining the F-14 fire control system (AWG-9) with extrapolations from the current DARPA sponsored design for an operational development model (ODM). The impact on the required airship size for obtaining a given level of performance from the airship/surface ship team is examined by varying the number of fire control units (AWG-9s) carried by the airship from 2 to 12. Costs of the proposed system are estimated. Scenarios are developed for convoy missions in a low to moderate ASCM threat environment and for surface battle group operations in a high threat (60, closely spaced ASCMs) environment. Measures of effectiveness for convoy protection are based on variations of achievable Depth-of-Fire by AAW escorts on attacking aircraft and ASCMs. Surface battle group AAW effectiveness is measured by calculation of the "saturation" level of ASCMs required to overwhelm individual "state of the art" AAW escorts. It is shown that using an airship/surface escort based AAW defensive system for convoys will halve the requirement for AAW surface escorts. In the surface battle group scenario it is shown that a combination of airships and older AAW escorts results in, a significant reduction in the total number of AAW escorts required to counter the ASCM threat, reduction in the number of escorts expected to receive damage during a raid, and the attrition of 90% of the attacking tactical aircraft. The cost of obtaining the indicated AAW capability over a 30 year life-cycle is shown to be at least 3 times lower when using an airship based system compared to using a combination of fixed-wing and helicopters.

MESSAGE NETWORK SIMULATION
Kuo-Tung Shih - Lieutenant Commander, Republic of China
(On Taiwan) Navy
B.S., Chung-Cheng Institute of Technology, 1978
Master of Science in Operations Research - March 1990
Advisor: R. Stemp - Department of Operations Research

This thesis presents a computer simulation of a multinode data communication network using a virtual network model to determine the effects of various system parameters on overall network performance.

ADAPTIVE LOGISTICS SUPPORT FOR COMBAT
Rogério Guerra da Silveira - Lieutenant, Brazilian Navy
B.S., Brazilian Naval Academy, 1979
Master of Science in Operations Research - September 1990
Advisor: D. P. Gaver - Department of Operations Research

The transient behavior of combat logistics support systems is analyzed. Combat availability is defined as the number of active combatant platforms being supported by a single fault diagnosis and repair facility. Heavy traffic conditions inherent to intense combat periods allow the use of diffusion approximation models, which provide speedy solutions used to compare adaptive scheduling policies to a standard First-Come, First-Serve policy. The adequacy of these models is investigated and numerical solutions are compared to simulation results. The case in which failed modules require a degree of support that is beyond the capability of local maintenance is also investigated for both pre- and post-local-repair relocation to distant repair. The use of cannibalization in short-term situations is shown to have a dramatic effect in terms of combat availability. A preliminary model for a noncannibalization policy is also developed. Optimization models for choosing spare parts allocation within budget constraints, or for achieving required operational availability with minimum cost are described.

**ANALYSIS OF THE U.S. NAVY TERMINATION MODEL FOR
PROCUREMENT CONTRACTS**

**Terence G. Smith - Lieutenant, Supply Corps, United States Navy
B.A., University of California, Los Angeles, 1977**

Master of Science in Operations Research - September 1990

**Advisors: A. W. McMasters - Department of Operations Research &
D. R. Henderson - Department of Administrative Science**

This thesis analyzes the Navy's procurement contract termination model, the mathematical model on which the Navy's Inventory Control Points will rely to determine whether to terminate procurement actions on items in long supply. The analysis focuses on which costs are relevant to the model and which costs are irrelevant. Suggestions for improvement are offered which include both eliminating irrelevant costs considered by the model and adding relevant costs not considered. Finally, the thesis evaluates the model's recommendations for terminations over a range of values of key model parameters to determine which parameters have the most impact on the model's decisions. Then it recommends further research in determining more precise values for those parameters with the largest effect on the model's decisions.

OPTIMAL ROUTING OF BATTLE GROUP VERTREP ASSETS

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B.S., The Pennsylvania State University, 1984

Master of Science in Operations Research - June 1990

Advisor: S. Lawphongpanich - Department of Operations Research

During battle group operations ships regularly require the transfer of material and personnel. The VERTREP of personnel and high priority cargoes is accomplished by logistics helicopter. This study describes an implicit enumeration algorithm to schedule the delivery route for a single helicopter. The algorithm employs a depth first search technique to solve the multiple constraint, multiple time window routing problem. Several fathoming techniques are demonstrated and computational results for eleven ship battle groups are presented.

**AN EMPIRICAL ANALYSIS OF ENLISTMENT INTENTIONS AND SUBSEQUENT
ENLISTMENT BEHAVIOR**

Richard Paul Snyder - Lieutenant, United States Navy

B.S., Tulane University, 1983

Master of Science in Operations Research - September 1990

**Co-Advisors: L. Gorman & G. W. Thomas - Department of
Administrative Science**

This research uses data from the Youth Attitude Tracking Survey and the Defense Manpower Data Center to predict interest in joining the military service (propensity) for the prime market of 17 to 21 year old high school diploma graduates that are expected to score above the fiftieth percentile on the military entrance examination. A follow-on analysis of actual conversion of propensity to enlistment action is also conducted. In predicting military interest, the independent variables were restricted to those that have data available on a regional level. This will enable military recruiting commands to develop regional estimates of propensity. Multinomial logistic regression was used to estimate the interest prediction equations for population groups by race and gender. Interest categorization was possible with reasonable accuracy using local unemployment level, parent's education and the regional 'go to college' rate as the independent variables. Conversion of military interest to enlistment action does appear to vary by interest level. Follow-on research and recommendations are provided.

DESIGN AND IMPLEMENTATION OF A PRIMAL SIMPLEX NETWORK OPTIMIZER IN C

Keith D. Solveson - Captain, United State Army

B.S., United States Military Academy, 1981

Master of Science in Operations Research - September 1990

Advisor: G. H. Bradley - Department of Operations Research

This thesis documents the design and implementation of an efficient primal simplex capacitated transshipment network optimizer, SNET, written in the C programming language. It describes a general symbolic network algorithm, discusses fundamental decisions regarding data structures and essential functions and their relationship to the network algorithm, and then details SNET's development. Development tools used in this project, including standard test problems, profilers, timing routines, external drivers, and debuggers, are also covered. The resulting solver, SNET, is quite fast on standard SNETGEN test problems, approximately twice as fast as a primal simplex network solver written in FORTRAN. The effect of tuning parameters on SNET's performance is minimal.

THE RELATIONSHIP BETWEEN OPERATIONAL GRAPHICS AND BATTLEFIELD SUCCESS

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B.S., United States Military Academy, 1981

Master of Science in Operations Research - September 1990

**Advisors: R. R. Read & D. A. Dyer - Department of
Operations Research**

This thesis analyzes deliberate attack missions conducted at the U.S. Army National Training Center (NTC) and evaluates the relationship between the operational graphics used and three unit performance measures of effectiveness (MOE). A methodology for categorizing and evaluating operational graphics is developed along with frequency of operational graphics usage information. A correlation between unit performance and operational graphics is established by comparing the graphics evaluations to the measures of effectiveness. Discriminant data analysis techniques attempting to further define a causal relationship proved inconclusive due to observation sample size and unquantified concomitant variables. The methodology and analysis contained in this thesis have application to both the creation of training standards for improvement of unit performance, and the evaluation of current operational graphics doctrine. Included within the research are descriptions of the NTC environment, Combat Training Center Archive, battalion task force organization, the use of operational graphics to portray deliberate attack missions, and the task force deliberate attack.

**DRAFTSMAN DISPLAYS FOR CONTINGENCY TABLES USING A FULL-SCREEN
SCROLLABLE APL2 SPREADSHEET INPUT/OUTPUT EDITOR WITH APPLICATION
TO THE PERSEREC DATABASE OF SPECIAL BACKGROUND INVESTIGATION**

Uwe H. Steinfeld - Captain, Federal Republic of Germany Army

Diplom-Mathematiker, University of Bielefeld, FRG, 1979

Master of Science in Operations Research - March 1990

Advisor: P. A. Lewis - Department of Operations Research

A full-screen scrollable spreadsheet-like editor written in the APL2 language is described for inputting, examining, and outputting data. Mixed numeric and character arrays can be read into or read out to formatted or comma delimited ASCII files. Alternatively a bulk mode input facility allows for rapid direct data entry, or data can be examined and edited cell-by-cell in the usual way. Columns, rows or blocks of data can be highlighted in a chosen color, shadowed, moved or copied. In addition APL functions entered on a command line can use the blocks as input or output. A facility for coding missing values is also provided. Output is obtained as a new spreadsheet, or equivalently as an APL2 matrix. In particular two-way cross-tabulations of multiple columns are laid out in the spreadsheet like draftsmen's plots to facilitate investigation and explanation of multivariate categorical data. No numerical coding of the data is needed. Flexible printing of arrays is provided, as well as lexicographic sorting of rows. A specific application of the techniques and the APL2 program is made to a database constructed with the author's assistance and maintained by the Defense Personnel Security Research and Education Center (PERSEREC) Monterey, California. This database is the basis of a large scale study of the special background investigation. The study is designed to evaluate the productivity of investigative sources in developing the necessary information to determine eligibility for access to sensitive compartment information.

A CARRIER DEPLOYMENT MODEL

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B.S., United States Naval Academy, 1983

Master of Science in Operations Research - September 1990

Advisor: S. Lawphongpanich - Department of Operations Research

Aircraft carriers are and will continue to be highly important to the United States as she safeguards her interests globally. Today's budget environment, however, demands efficient use of these carrier assets in meeting their station coverage assignments. In a peacetime environment, a carrier's ability to cover a station is constrained by depot maintenance, training cycles, and the Chief of Naval Operations personnel and operating tempo program (PERSTEMPO/OPTEMPO). To aid in satisfying this demand on carriers, a mixed integer programming model is developed. The output from the model provides optimal station coverage assignments for a given level of coverage under constraints associated with carrier operations. When implemented in conjunction with the General Algebraic Modeling System (GAMS), the model requires minimal user inputs and is implementable on a personal computer. Other applications of the model are also demonstrated in several examples.

SIMULATION ANALYSIS OF MULTI-STATIC ASW IN THE GIUK GAP

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B.S., The Citadel, 1983

Master of Science in Operations Research - September 1990

Advisor: R. N. Forrest - Department of Operations Research

This thesis examines an encounter between a submarine transiting the Greenland, Iceland, United Kingdom (GIUK) gap, and a surface ship patrolling the gap. The surface ship is one of two components of a multi-static ASW detection system, the other component being a fixed receiver field in the area of transit. A simulation is utilized to model the encounter which measures the mean number of detections during the submarine's transit, the mean time of first detection, and the mean distance at first detection between the surface ship and the submarine, for various detection criteria.

**ANALYSIS OF ENGINEER C2 AS MODELED BY STOCHASTIC, TIMED
ATTRIBUTED PETRI NETS**

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B.S., Geneva College, 1981**

Master of Science in Operations Research - September 1990

**Advisors: W. J. Caldwell & R. R. Read - Department of
Operations Research**

Engineer command and control in a mechanized corps is a complex system. The current doctrine for engineer force structures is inadequate. Three command and control alternative force structures, identified in the Engineer Structure Study, are evaluated to determine which structure best supports a mechanized corps. The analysis is based on the results of a Stochastic, Timed, Attributed Petri Net timed stepped simulation. The model used in this simulation was constructed using an interactive graphical design tool, called Modeler, by a team including the software developer ALPHATECH, the U.S. Army Engineer Center, and the Training and Doctrine Analysis Command. This was the Army's first use of Modeler. The C2 performance of the engineer staffs is simulated for each of the three force structures by simulation message traffic and processing for 15 days of war in three settings, offense, defense and transitioning from offense to defense. The force structures are then analyzed by comparing simulation output using three measures of performances: Message Processing Capacity, Message Quality, and Message Processing Speed. The Division Engineer alternative consistently out performs the Base Case and Company Restructure alternatives for each measure of performance and in each of the three settings. Therefore based on these simulations, the Division Engineer alternative is the best force structure to support a mechanized corps.

A CHEMICAL CASUALTY MODEL

**Paul D. Thornton - Captain, United States Army
B.A., Shippensburg State College, 1981**

Master of Science in Operations Research - September 1990

Advsior: L. D. Johnson - Department of Operations Research

Currently, to plan chemical weapons' use on the battlefield, planners use the classified chemical weapon effects tables contained in FM 3-10B and look up the expected casualties based on the meteorological and target conditions. This can be a lengthy and time-consuming process especially when many weapons are available and/or many targets are under consideration. Mathematical models could significantly improve both the speed and accuracy of the current procedure and thus allow chemical weapons to be exercised more frequently. This thesis develops a model for one chemical agent and delivery system. A large simulation experiment was conducted to gather the expected number of casualties for each combinations of meteorological and target conditions. The results were then fit to one model through multivariate regression to provide one equation that models the expected number of casualties from this one agent. Future work could easily expand on this effort to include other agents and weapon systems.

**INVESTIGATION OF INITIAL DETECTION MODELS IN THE SEARCH AND
LOCALIZATION TACTICAL DECISION AID (SALT)**

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Master of Science in Operations Research - September 1990

Advisor: A. R. Washburn - Department of Operations Research

The goal of this thesis is to investigate the initial search planning phase of the Search and Localization Tactical Decision Aid (SALT) developed by METRON, Incorporated of McLean, Virginia. SALT is a Computer Assisted Search (CAS) program intended for use by P3 UPDATE IV crews to assist them in optimal deployment of a sonobuoy field to prosecute a submarine threat. The initial search planning phase of SALT takes as user inputs environmental data, an initial elliptical Search Probability Area (SPA), an assumed target motion model, and the duration of the search. Outputs include a recommended sonobuoy pattern and the probability of detection of this pattern. The investigation of this phase of the algorithm is conducted in two parts. First, a series of simulation routines is used to ensure that the probability of detection of the sonobuoy patterns generated by SALT is mathematically correct. Second, these same simulation routines are used to determine if there are alternate sonobuoy patterns that result in higher probabilities of detection.

**THE FEASIBILITY OF SPECIALIZED SUB-COMMUNITIES WITHIN THE GENERAL
UNRESTRICTED LINE OFFICER COMMUNITY**

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Master of Science in Operations Research - September 1990

Advisor: P. R. Milch - Department of Operations Research

This thesis analyzes the feasibility of reorganizing the General Unrestricted Line community into six specialized sub-communities, while maintaining the requirements for leadership and subspecialty development prescribed by the current career path. FORECASTER, an interactive personnel flow model was used in the analysis. Steady state analysis was conducted for each sub-community to determine long term feasibility. Transient analysis was conducted to determine if feasibility could be achieved in a reasonably short period of time. The results of the analysis indicate that while reorganization into sub-communities is theoretically feasible it is not practical in the short term.

SEQUENTIAL ESTIMATION OF OPTIMAL AGE REPLACEMENT POLICIES

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Master of Science in Operations Research - September 1990

Advisor: L. R. Whitaker - Department of Operations Research

Under an age replacement policy a system is replaced at a fixed age ϕ or at failure whichever comes first. If the cost of replacing the system before failure is less than the cost of replacing it at failure, this type of maintenance policy can lead to considerable savings. An often used criterion for finding an "optimal" replacement age ϕ , is to minimize the long run expected cost per unit time of a policy with replacement age ϕ . This cost function clearly depends on the underlying distribution of the system lifetimes. When this distribution is unknown, the cost function and hence ϕ^* need to be estimated. In this thesis, we study the large and small sample properties of a procedure which estimates ϕ^* . In particular, we study sequential maximum likelihood estimators of ϕ^* which are updated at each replacement based on the replacement history of the system so far. In this sequential procedure each system is subject to the age replacement policy with estimated ϕ^* based on all the data gathered so far. This type of procedure should control the actual cost per unit time while gathering data needed to estimate ϕ^* . This thesis contains a detailed description of the sequential estimation procedure when the underlying system life times have a Weibull distribution and a Gamma distribution. Monte-Carlo methods are then used to study the behavior of the estimated optimal age replacement times and more importantly the actual costs per unit time for different sample sizes, costs and choices of the underlying Weibull and Gamma distributions.

A HIERARCHICAL GAMMA/WEIBULL REGRESSION MODEL FOR TARGET DETECTION TIMES

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Naval Academy, 1986**

Master of Science in Operations Research - September 1990

Advisor: P. A. Jacobs - Department of Operations Research

Combat models often involve target detection times which may vary with different observers due to characteristics of personnel, or detection systems. They may also be affected by different environmental factors such as visual levels, sea states, terrains, etc. There is often interest in quantifying the effects of different observer characteristics and environmental factors on detection times. A hierarchical gamma/Weibull regression model is considered which can incorporate observer characteristics and environmental effects which may influence the time to detect targets. Numerical procedures for the estimation of parameters of the hierarchical gamma/Weibull model based on maximum likelihood are described. Results of simulation experiments to study small sample behavior of the estimates are reported.

A QUESTION OF UTILITY

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B.S., U.S. Military Academy, 1972**

Master of Science in Operations Research - September 1990

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In accordance with the 1988 Army Aviation Modernization Plan, the Army entered contractual agreement to begin acquisition of 2,253 UH-60 utility helicopters to replace approximately two-thirds of the 3,147 UH-1 aircraft destined for retirement. The plan foresaw the newer aircraft assuming the majority of the utility mission with the residual balance of UH-1 helicopters assuming a supplementary role. Because of subsequent budgetary considerations, the decision was reached to stop purchasing replacement aircraft after the close of Fiscal Year 91. By that time the Army's total procurement will have reached 1,147 aircraft, considerably short of the established target. Army planners now face the difficult task of reconfiguring the utility fleet with available assets to satisfy future service needs. Although not immediately obvious, this new challenge has arisen at a fortuitous moment. Recent political changes manifest within the Warsaw Pact nations and the Soviet Union have clearly vindicated our strategy of preparing for war in Europe to prevent its onset. Threat analysis now suggests that the most likely use of U.S. military force resides in the low intensity conflict (LIC) theater. Recognizing that the UH-60 was designed to prosecute mechanized war, the question of its application to LIC rests largely on speculation. Now, before irrevocable decisions are made to retire the majority of the UH-1 fleet, the Army must determine which of the two aircraft will better serve our future needs. Another environment-technology mismatch reminiscent of the aborted hostage rescue attempt would be inexcusable. As a preliminary comparison a semi-Markov process was formulated for forecast performance of both aircraft in desert, mountain and jungle environments during day and night conditions. The model incorporated segments from five standard utility helicopter missions into a Markov chain and predicated eight different measures associated with survivability and mission accomplishment. The results were somewhat surprising. All factors relating to survivability confirmed the UH-60 the superior aircraft throughout the entire range of scenarios. This conclusion is consistent with UH-60 design specifications relating to cashworthiness and ballistic tolerance which were specifically established to correct deficiencies noted in the UH-1 during the Vietnam War. However, concerning mission accomplishment, the UH-1 proved to be the better aircraft across all environmental variations. Similarly, when operational costs of the two helicopters were compared, expenses associated with the UH-60 were twice those of the UH-1. The main impact of these findings concerns the fact that neither aircraft emerges the clear winner. This analysis can be easily expanded to perform a more thorough comparison based upon measures selected by Army leadership. Armed with such results, the Army can make informed decisions regarding the future composition of the utility fleet.

**ANALYSIS OF OPTIMUM DEPOT LEVEL COMPONENT REPLACEMENT POLICY
FOR RETROGRADED M1 ABRAMS TANKS**

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B.S., University of Nevada (Reno), 1981

Master of Science in Operations Research - September 1990

Advisor: L. R. Whitaker - Department of Operations Research

This study examines 48 M1 tank components for possible application of an optimum age replacement policy. The purpose is to support a broader study associated with the Reliability Centered - Inspect and Repair Only as Necessary (RC-IRON) program. The program provides depot level maintenance to tanks transferred to retrograded from Germany to the United States. An optimal age replacement policy reduces the number of failures while minimizing the cost associated with failure by replacing some older components before they fail. The component data for this analysis was drawn from the Field Exercise Data Collection (FEDC) at the National Training Center (NTC), Fort Irwin, California. This thesis begins with a discussion of a methodology for determining an optimal replacement time. Distribution analysis is performed on component lifetimes as well as delay and repair times due to failure. The various costs associated with failure are estimated. The application of an age replacement policy was found to be beneficial for a few components and only when they had a high down-time cost. A graphical procedure is used to show sensitivity of the optimum policy to changes in cost. Component simulations are performed to pretest the results of a proposed maintenance policy. A six component system is simulated to demonstrate how the components could be tied together for later system level analysis. Although this study deals with the M1 Abrams tank, the methodology and procedures detailed may be applied to other systems with components that wear out.

VHA MODEL REVIEW

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Master of Science in Operations Research - March 1990

Advisor: L. Johnson - Department of Operations Research

A regression model is used by the Office of the Secretary of Defense (OSD) to predict median rents so as to find variable housing allowance (VHA) as a supplement to Basic Allowance for Quarters (BAQ). These allowances are made for service members in the continental United States. It is this model that is reviewed in this thesis. Median rental data taken from the annual VHA survey are used to test this model. From this analysis, the model indicates lack of fit, invalid assumptions and perhaps not even a "reasonable" approach. A more sensible approach is used to propose two other regression models. These models are a Weighted Regression Model which, like the current model, predicts medians; and an Analysis of Covariance model which predicts or analyzes the mean rent. More reasonable predictions of median and mean rent are indicated by these two models respectively.

ANALYSIS OF ENLISTMENT INCENTIVES FOR HIGH QUALITY RECRUITS TO THE UNITED STATES ARMY

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B.S., United States Military Academy, 1980
Master of Science in Operations Research - September 1990
Advisors: L. Johnson - Department of Operations Research & G.
Thomas - Department of Administrative Science**

This thesis analyzes data from the 1988 New Recruit Survey (NRS) sponsored by the United States Army Recruiting Command to study incentives that motivate new recruits to enlist in the United States Army. Our purpose is to use discriminant analysis and logistic regression to identify those incentives that have the greatest effect on enlistees in the prime recruiting market and to compare the results of these two methods. We believe that the incentives identified will differ between high quality and non-high quality individuals where a high quality individual is defined as one who has a high school diploma and scores in categories I through IIIA on the Armed Forces Qualification Test (AFQT). Demographic variables such as an individual's marital status and time spent in the labor force prior to enlisting in the Army were shown to influence enlistment incentives. Further, factor analysis of NRS responses identified four underlying factors which influenced recruits' enlistment motivations. However, these factors differed between racial groups and accurate models could only be developed for each racial group separately.

SEQUENTIAL ESTIMATION OF AGE REPLACEMENT POLICIES

**Yang-Huang Wu - Major, Republic of China Army
B.S., Chung-Cheng Institute of Technology, R.O.C., 1977
Master of Science in Operations Research - March 1990
Advisor: L. R. Whitaker - Department of Operations Research**

Optimal maintenance policies are designed to reduce the number of system failures and minimize the cost of repair by scheduling planned replacements. In this area the problem of updating the maintenance policy using the past maintenance history has not been adequately solved. In this thesis we study a sequential estimation procedure in a nonparametric setting to estimate the age replacement policy that minimizes long run expected maintenance costs. This thesis begins with the discussion of the concepts of preventive maintenance, age replacement policies, the settings of our simulation model, and a detailed description of the sequential estimation procedure. We include examples using actual replacement data which demonstrate the usefulness of the sequential estimation procedure. Monte-Carlo methods are used to study the behavior of estimated optimal age replacement policy for different sample sizes, costs and underlying system life distributions. We also make comparison with Frees and Ruppert's (1985) sequential procedure for estimating optimal age replacement policies. These comparisons show that our sequential estimation procedure is competitive and for large sample sizes performs better than the Frees and Ruppert's procedure. Finally, we will introduce a graphical method to estimate the optimal age replacement policy.

APPROXIMATE INTERVAL ESTIMATES FOR MECHANICAL RELIABILITY

**Wen-Huei Yang - Commander, Taiwan Navy
B.S., Chinese Naval Academy, 1976
Master of Science in Operations Research - September 1990
Advisor: W. M. Woods - Department of Operations Research**

Two approximate interval estimation procedures for mechanical component reliability, $P(X > Y)$, are developed and their accuracy evaluated by computer simulations. The strength, X , of the component and the stress, Y , applied to it are independent normally distributed variables with unknown means and variances. In the first interval procedure the variances are equal. In the second procedure the variances may be unequal. The derived intervals are quite accurate for the cases simulated which include large and small sample sizes. These procedures are simple to apply and require the use of percentile points of the Student's t distribution. In the second procedures, the degrees of freedom of the associate t statistic is a function of the test data, and therefore it is random.

**MASTER OF SCIENCE
IN
PHYSICS**

MEASUREMENT OF THE SPACE THERMOACOUSTIC REFRIGERATOR PERFORMANCE

Jay Andrew Adeff

B.S., University of California, Los Angeles, 1987

Master of Science in Physics - September 1990

Advisor: T. J. Hoffer - Department of Physics

This is the fifth thesis of the Space Thermoacoustic Refrigerator (STAR) project which will be launched aboard the Space Shuttle in 1991 to demonstrate the potential of this technology for cooling satellite electronics and sensors. It describes the design, construction, and testing of the resonator portion of the refrigerator along with its integration with the existing driver and control electronics which were the subject of our previous theses. This resonator incorporates a helium diffusion barrier enabling it to hold ten atmospheres of working gas without leaking. An optimum operating frequency has been chosen based on electroacoustic efficiency measurements and the refrigerator has been allowed to run continuously and autonomously for up to one week at a time to simulate the planned space flight. A lowest temperature of -50°C at a temperature ratio of $T_c/T_h=0.75$ and a maximum coefficient of performance relative to Carnot of 14 percent has been obtained.

A CALIBRATION OF THE NAVAL POSTGRADUATE SCHOOL MIDDLE ULTRAVIOLET SPECTROGRAPH AND AN ANALYSIS OF THE OII 2470 A AND OI 2972 A EMISSIONS OBTAINED FROM MID-LATITUDE ROCKET OBSERVATIONS

Carl K. Andersen - Lieutenant, United States Coast Guard

B.A., United States Coast Guard Academy

Master of Science in Physics - September 1990

Advisor: D. D. Cleary - Department of Physics

The MUSTANG instrument was calibrated using standard techniques to determine the sensitivity and wavelength calibrations and field of view. The instrument was launched aboard a NASA sounding rocket on March 30, 1990. Post-flight tests indicated that the calibration did not change as a result of the rocket experiment. Ultraviolet dayglow spectra of the Earth's ionosphere were obtained from approximately 100 km to 320 km in altitude over a wavelength range of 1800 A to 3400 A. The spectra were divided into 512 pixels of approximately 3.134 A per pixel. Analyses of the data from 2420 A to 2490 A and from 2920 A to 2972 A were conducted to obtain the intensity profiles of the OII 2470.4 A multiplet and the OI 2973.3 A line emission, respectively. The intensity profile of the OII 2470.4 A multiplet was found to have a broad peak of 1.6 kR centered at approximately 250 km. The intensity profile of the OI 2972.3 A line emission shows a general trend of decreasing intensity with altitude. The maximum intensity of 3.6 kR was found at 105 km and the minimum of 137 R at 315 km. A partial layer, with an intensity of 4.1 kR, was evident near 150 km.

REAL-TIME IMAGING OF INFRARED SCENE DATA GENERATED BY THE NAVAL POSTGRADUATE SCHOOL INFRARED SEARCH AND TARGET DESIGNATION (NPS-IRSTD) SYSTEM

Michael James Baca - Lieutenant, United States Coast Guard

B.S., United States Coast Guard Academy, 1983

Master of Science in Physics - September 1990

Advisor: A. W. Cooper - Department of Physics

A system to display images generated by the Naval Postgraduate School Infrared Search and Target Designation System (a modified AN/SAR-8 Advanced Development Model) in near real time was developed using a 33MHz NIC computer as the central controller. This computer was enhanced with a Data Translation DT2861 Frame Grabber for image processing and an interface board designed and constructed at NPS to provide synchronization between theIRSTD and Frame Grabber. Images are displayed in false color in a video raster format on a 512 by 480 pixel resolution monitor. Using FORTRAN, programs have been written to acquire, unscramble, expand and display a 3° sector of data. The timeline for acquisition, processing and display has been analyzed and repetition periods of less than four seconds for successive screen displays have been achieved. This represents a marked improvement over previous methods necessitating slower Direct Memory Access transfers of data into the Frame Grabber. Recommendations are made for further improvements to enhance the speed and utility of images produced.

ANALYSIS OF THERMOSPHERIC DAYGLOW SPECTRA FROM THE SPACELAB 1 SHUTTLE MISSION

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B.S., University of Idaho, 1983
Master of Science in Physics - December 1989
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Lower thermospheric airglow spectra in the wavelength range of 1840 Å to 2280 Å were analyzed. These data were obtained by the Spacelab 1 shuttle mission in November, 1983. The analysis of the seven spectra was accomplished by comparison of the data with synthetically calculated spectra for the gamma, delta, and epsilon band emissions of nitric oxide. The tangent ray heights of the measured spectra varied in two kilometer increments from 96 km to 108 km. The strengths of 31 of the most prominent γ , δ , and ϵ band emissions were independently adjusted to achieve the best fits to the data. All of the major features in the data were identified and gave conclusive evidence of the existence of ϵ band emissions. By fitting the double bandhead feature of the emissions, the atmospheric temperature was determined for the first time from the NO emissions and compared with the temperature profile predicted by the MSIS-83 model. The Frank-Condon factors for the v'' progression ($v''=0$) of the nitric oxide ϵ band were measured from the data and compared with theoretical calculations. The fluorescence efficiency of the δ bands was determined to be 0.32 ± 0.05 by fitting the δ (0,1) emission feature. Finally, a discrepancy between the observed and calculated relative intensities of the two sub-bands for the γ and ϵ bands was found.

OBSERVATION AND ANALYSIS OF OPTICAL TRANSITION RADIATION AT THE NPS LINAC AND ITS USE FOR DIAGNOSTICS OF ELECTRON BEAMS

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B.S., United States Naval Academy, 1984
Master of Science in Physics - June 1990
Advisor: X. K. Maruyama - Department of Physics

An experimental technique for observing Optical Transition Radiation, (OTR), that is both simple and effective, is shown. A Macintosh II computer equipped with an image frame grabber board and *Image* software package allows for extensive analysis of the captured electron beam spot OTR patterns. The equipment is capable of measuring relative intensities to better than 1% for a constant source image. With beam energies of nearly 100 MeV the captured OTR images show an unexpected asymmetry in the beam intensity profile. The variations of the beam intensity and shape are shown for nominally steady beam conditions. Using *Image*, integrated signals of the beam spot OTR patterns for several targets as a function of beam current show a linear relationship, thereby creating a technique for computing electron beam current. Portions of the beam profile with varying percentages of beam spot maximum intensity also show a linear relationship between beam current and OTR image intensity. A radiation cone OTR pattern has been observed for the NPS linac beam. From the pattern, the Lorentz factor for the 100 MeV electrons is observed to be less than the computed value, and probably indicates the non-collinearity of the electron beam.

ANALYSIS OF THE ULTRAVIOLET EMISSIONS OF NITRIC OXIDE FROM MID-LATITUDE ROCKET OBSERVATIONS

Michael J. Clayton - Lieutenant, United States Navy
B.A., University of California at Berkeley, 1982
Master of Science in Physics - June 1990
Advisor: D. D. Cleary - Department of Physics

Ultraviolet emissions of the Earth's ionosphere in the wavelength range of 2000 Å to 2500 Å are analyzed. These data were obtained by a rocket-borne spectrograph flown on March 30, 1990 from the White Sands Missile Range, New Mexico. The gamma and epsilon bands of nitric oxide dominate this portion of the spectrum. Column densities of nitric oxide are determined by fitting eleven of the most prominent bands with synthetic spectra. Additionally, a temperature profile is found between the altitudes of 145 km and 195 km. From these data, corrections to the Franck-Condon factors are determined for three v'' progressions of the nitric oxide gamma bands.

ESTABLISHMENT OF A CAPABILITY TO MEASURE OPTICAL TRANSITION RADIATION

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B.S., United States Naval Academy, 1984

Master of Science in Physics - December 1989

Advisor: X. K. Maruyama - Department of Physics

Optical transition radiation (OTR) can be used as a beam diagnostic system for charged particle beams. The experimental setup developed here demonstrates the capability to observe and measure OTR due to an electron beam from a linear accelerator. The setup is compact, simple, and readily adapted to experimental work. Through the use of two software programs (QuickCapture and Image 1.14) and the QuickCapture frame grabber board, both qualitative and quantitative results are possible. One of the useful qualitative results is a three-dimensional beam profile, which is quickly produced from a captured image. The system measured the relative intensity with a 3% variation between several images of the same source. Angular measurements of OTR can be made with an angular resolution of 600 microradians.

IDENTIFICATION OF THERMOSPHERIC DAYGLOW EMISSIONS FOR THE MUSTANG EXPERIMENT

Gary Michael Danczyk - Captain, United States Army

B.S., United States Military Academy, 1979

Master of Science in Physics - December 1989

Advisor: D. D. Cleary - Department of Physics

Thermospheric airglow emissions in the wavelength range of 1800A to 3400A, and altitude range of 100 to 330 km were identified. These emissions compose the preliminary data analysis for the Naval Post Graduate School MUSTANG rocket experiment, scheduled for launch from White Sands, New Mexico in February of 1990. Identification of emissions in the wavelength range of the MUSTANG experiment was accomplished using experimental results to support calculated emission feature intensity. All emission features that will contribute to the experimental spectra, as well as those features that will be distinguishable have been tentatively identified. These results confirm the contention that the instrument wavelength range allows observation of major midultraviolet airglow emission bands. The extended wavelength and altitude range for this experiment allows a unique experimental opportunity to observe all major neutral atmospheric constituents in one spectrum. The primary emission band systems that will be observed are the N2 Lyman-Birge-Hopfield bands, the O2 Schumann-Runge bands, the NO Gamma bands and the O 2972A line. Secondary contributions will be observed from the N2 Vegard-Kaplan and 2nd Positive bands, the O2 Herzberg bands, and the NO Epsilon and Delta bands. These combined spectra will insure the MUSTANG experimental goal of measuring N2 and NO densities and determining EUV and photoelectron fluxes can be met.

SURFACE DYNAMICS OF UNIPOLAR ARCING

Richard Keith Downs - Lieutenant, United States Navy

B.S., University of Texas-Austin, 1981

Master of Science in Physics - December 1989

Advisor: F. R. Schwirzke - Department of Physics

A 4.55 microsecond, 15 Joule pulsed CO2 laser was used to illuminate a copper target. Bulk plasma was found to be emitted normally to the target surface independent of the laser angle of incidence over the range of $45^\circ \pm 15^\circ$. Material ejected from a copper target was allowed to deposit onto polished type 304 stainless steel surfaces. The ejected material deposited in concentric 'rings' in many places. The mechanisms for this is unknown. Polished type 304 stainless steel surfaces were coated with one to ten micron copper films and shot with the laser. Damage to the films indicate that the damage mechanism may simply be joule heating from the arc current. This lead to a procedure for calculating that arc current. The arc lifetime is necessary but still unknown. No correlation was found between unipolar arc pit diameter and depth. Investigations into the role of surface tension on the dynamics of the molten surface lead to a comparison between unipolar arcing and arc welding. Much of the physics known about arc welding is qualitatively applied to describe the surface dynamics of molten metal produced by unipolar arcing.

EVALUATION OF A POTENTIAL WAVE DIVISION MULTIPLEXER (WDM) FOR USE IN THE IRSTD

**Paul Thomas Fernan - Lieutenant, United States Navy
B.S.E.E., United States Naval Academy, 1983
Master of Science in Physics - December 1989
Advisor: D. D. Cleary - Department of Physics**

The design of a Wave Division Multiplexer (WDM) was evaluated. This design could be used in the AN/SAR-8 infrared search and target designation system currently being developed by the Navy. The design featured a spherical grating with a radius of curvature of 115 mm to test the capability of multiplexing 180 channels. The grating was able to couple light from laser diodes at four different wavelengths (780.0nm, 789.0nm, 848.0nm and 849.0nm). The most significant factor in coupling efficiency was astigmatism. This decreased the demultiplexing coupling efficiency by a factor of 500. The source linewidths were measured to assess the possibility of wavelength slicing. The capability to multiplex 180 channels is possible but cannot yet be achieved due to the lack of light sources that cover the wavelength range required for 180 channel system.

COMPUTER MODEL OF THE PERFORMANCE OF A THERMOACOUSTIC GENERATOR

**Paul Douglas Fisher - Lieutenant, United States Navy
B.S.E.S., Purdue University, 1981
Master of Science in Physics - June 1990
Advisor: A. A. Atchley - Department of Physics**

A computer program is developed to predict the performance of a thermoacoustic generator. The defining relationships are based on equations derived using short stack and boundary layer approximations. The engine modeled is the five inch engine currently in operation at Los Alamos National Laboratory. The working fluid in the model is a helium-argon gas mix, chosen to provide flexibility in placing the transducer relative to the thermoacoustic stack assembly while maintaining resonance near the desired operating frequency of 120 Hz. The transducer model is based on a linear alternator design proposed for use with the L.A.N.L. engine in the future. The thermodynamic properties of the gas mix are determined using virial equations and binary gas mixture relationships. The defining relations are solved simultaneously and an iterative process is used to optimize the gas mix. The variables for which the program then solves are pressure amplitude, hot heat exchanger temperature, and angular frequency as functions of input heat flux, system geometry, and load characteristics. From these, the power output and total system efficiency are determined.

PHYSICAL PROCESSES IN HOLLOW CATHODE DISCHARGE SOURCES

**Hwang-Jin Han - Major, Republic of Korea Army
B.S., Republic of Korea Military Academy, 1981
Master of Science in Physics - December 1989
Advisor: R. C. Olsen - Department of Physics**

The hollow cathode is an effective source of dense, low energy plasma. Hollow cathodes find use in ion beam sources for laboratory and space applications. They can also be used independently for satellite charge control, and ion beam neutralization. A heaterless hollow cathode design was tested with argon gas used as the propellant. This thesis work investigated the device properties, that is, the emission currents as a function of discharge current, propellant flow rate and other physical parameters. Starting behavior was a main point of the investigation. The results of these experiments were compared with studies of the conventional hollow cathode.

**DOSE ANALYSIS OF THE MODEL 112A PULSERAD PULSED X-RAY
GENERATOR BY ITS/CYLTRAN**

**Jong Ryual Kim - Major, Republic of Korea Army
B.S., Republic of Korea Military Academy, 1980
Master of Science in Physics - December 1989
Advisor: X. K. Maruyama - Department of Physics**

The radiation output from the NPS Pulserad 112A X-ray Generator has been calculated using the ITS code CYLTRAN. The results of this numerical simulation have been compared to the experimental measurements taken previously. These calculations show that the overall photon energy spectrum is independent of the electron source beam parameters such as beam radius and angular distribution. A previously unexplained measured dip in the radiation dose at the beam center line can be explained with an angular divergence of the electron beam from the cathode. The simulation is successful in explaining the pattern of the dose distribution, but the calculation is in general much smaller than the measured values. This inability to reproduce the magnitude of the dose pattern points out the need to measure the radiation dose each time the Pulserad 112A is used. Some suggestions for explaining this discrepancy are included.

**ANALYSIS OF RADIO FREQUENCY RADIATION
FROM A PROPAGATING ELECTRON BEAM**

**Richard W. Lally - Captain, United States Army
B.S., Stonehill College, 1979
Master of Science in Physics - June 1990
Advisor: J. R. Neighbours - Department of Physics**

An experiment was conducted which measured the Radio Frequency (RF) radiation from the PHERMEX accelerator, capable of 30 MeV and 600 A. This was accomplished by placing TEM horn antennae at varying angles from the path of the electron beam. The signals received by the antennae were then recorded by using a Digitizing Camera System (DCS). Measurements were taken of the radiation from propagating and non-propagating beams, beams with energy above and below Cherenkov threshold, and beams varied currents. The captured RF signals and their corresponding frequency spectra were then analyzed. This analysis showed that the radio frequency radiation from the beams below the Cherenkov threshold contained primarily transition radiation; when above, diffracted Cherenkov radiation was observed. Non-propagating beams produced larger-angle radiation and had less definition in their spectrum. All electric fields measured were proportional to the beam current. Lastly, the electron beam pulse width and separation were determined by both the received signals and their spectrum.

**HIGH RESOLUTION C^2 AND RADIAL WIND VELOCITY MEASUREMENTS
USING A HIGH FREQUENCY MONOSTATIC ACOUSTIC ECHOSOUNDER**

**James Kernan McCrary - Lieutenant, United States Navy
B.S., Virginia Military Institute, 1982
Master of Science in Physics - June 1990
Advisor: D. L. Walters - Department of Physics**

Atmospheric turbulence, in the form of temperature induced density fluctuations, degrades the coherence of electromagnetic and acoustic energy propagating through the atmosphere. It is known that a very large portion of atmospheric turbulence lies within the surface boundary layer of the atmosphere. The detection and quantization of low level turbulence and correlation to the structure of the atmospheric surface layer is therefore one of the primary objectives in the site selection and design stage of any new ground-based optical telescope facility. The thrust of this thesis was the development of a Doppler wind determination algorithm via a method known as pulse-pair processing. This algorithm was incorporated in a previously developed acoustic echosounder and associated software giving the echosounder a radial wind profiling capability up to approximately 150 meters above the surface. Using this system, measurements were taken at two sites being considered for a new telescope facility as well as the Naval Postgraduate School. Results obtained at these sites show the validity of this method of wind speed determination. This new capability makes the high resolution, portable, acoustic echosounder an even more powerful research tool for use in the study of atmospheric turbulence and boundary layer meteorology.

**TRANSFORMATION OF A FINITE-ELEMENT MODEL OF A PIEZOELECTRIC SPHERICAL SHELL
TRANSDUCERS FROM A NODAL TO A SPHERICAL HARMONIC FUNCTION REPRESENTATION**

Kathleen Ann McLean - Lieutenant, United States Navy

B.S., Tufts University, 1980

Master of Science in Physics - June 1990

**Advisors: S. R. Baker - Department of Physics & C. L. Scandrett
Department of Mathematics**

A new method of array modeling which will be used to predict the performance of low frequency active sonar arrays is being investigated. In support of this effort, a network representation of a spherical shell piezoelectric transducer was developed. The transducer was modeled using the finite element code MARTSAM, from which a nodal description of the transducer was obtained. A procedure was developed to reduce and transform the nodal description of the transducer into a spherical harmonic description. The spherical harmonic description of the transducer was computed at two frequencies, 112.5 Hz and 1125.3 Hz, corresponding to values of ka of 0.1 and 1.0, respectively, where a is the radius of the sphere.

UNIPOLAR ARCING ON THE CATHODE SURFACE OF A HIGH VOLTAGE DIODE

Stephen Anthony Minnick - Lieutenant, United States Navy

B.S., Pennsylvania State University, 1981

Master of Science in Physics - December 1989

Advisor: F. Schwirzke - Department of Physics

The idea of electron emission from an exploding cathode whisker has been reported on many times by various research groups. However, since the reported estimates of current density from the cathode spots vary widely over several orders of magnitude, it is clear that the actual mechanism of explosive emission is not well understood. Plasma surface interaction via unipolar arcing can be shown to be able to supply the necessary current density to initiate explosive emission. Joule heating of the whisker by unipolar arcing is much greater than for either field emitted or space charge limited current flow. It has now been shown experimentally that unipolar arcing occurs not only in a laser induced plasma surface interaction, but also in a vacuum diode discharge at the cathode surface. The unipolar arcing process forms the initial breakdown plasma in each case.

EXPERIMENTAL ANALYSIS OF B-DOT SENSORS

Holly Lawrence Nye - Lieutenant Commander, United States Navy

B.S., Oregon State University, 1976

Master of Science in Physics - June 1990

Advisor: J. Neighbours - Department of Physics

A new design for non-self integrating magnetic-loop sensors (B-dots) has been developed at Los Alamos National Laboratory. Experiments and tests performed using the Relativistic Electron Beam Experiment (REX) machine to compare the B-dot sensors to optical beam diagnostics (streak camera). The B-dots were assessed to have the capability of measuring the REX electron beam's position to within 0.25mm with 2 percent error, and its transverse oscillatory movement to within 0.55mm amplitude with 7 percent error, over a 1 GHz bandwidth. Many calibration parameters and factors affecting sensor signals were examined during the experiment. The experimental calibration of the B-dots, and the resulting certified accuracy of their remote, non-intrusive measurements of relativistic electron beam parameters should have a wide range of application to many other electron beam machines.

HOLLOW CATHODE PLASMA SOURCE CHARACTERISTICS

Young-Chul Park - Lieutenant, Republic of Korea Navy

B.S.E.E., Korean Naval Academy, 1982

Master of Science in Physics - December 1989

Advisor: R. C. Olsen - Department of Physics

The experimental and theoretical research results on plasma and its sources are presented. This work involves characterizations of useful qualitative descriptions of the basic physical processes taking place within a vacuum chamber and hollow cathode. The purpose of this experiment is to determine the minimum operating power and stable conditions of a standard, commercial hollow cathode plasma source. The results of this experiment will be compared with the results produced by other plasma laboratories.

MONTE CARLO GENERATION OF CERENKOV RADIATION

Richard J. Phillips - Captain, United States Army

B.S., United States Military Academy, 1979

Master of Science in Physics - December 1989

Advisor: X. K. Maruyama - Department of Physics

The integrated Tiger Series (ITS) code family, produced at Sandia National Laboratories, Albuquerque, NM, model the transport of electrons/photons. These codes are used in many applications such as radiation shielding and radiation dose prediction. A method of adding Cerenkov radiation to the output capabilities of the code was devised by Joseph Mack of Los Alamos National Laboratory and Thomas Jordan of Experimental and Mathematical Consultants. This method has been extended to include the effects of wavelength dependent indices of refraction. The capability to handle air and carbon dioxide gas at different pressures and temperatures has been added to the program. The modifications to the code patch provide the user with wavelength information on the Cerenkov spectrum which shows 44 percent more production in the 1800 to 2000 angstrom wavelength bin than calculated by the Mack-Jordan patch. These additions to ITS provide a potentially valuable tool for design and implementation of Cerenkov detectors.

LITHIUM ION SOURCE FOR SATELLITE CHARGE CONTROL

Tae Ik Song - Captain, Korean Army

B.S., Military Academy of Korea, 1983

Master of Science in Physics - June 1990

Advisor: R. C. Olsen - Department of Physics

A lithium ion source using thermal emission from mineral β -eucryptite has been investigated as a possible control device for spacecraft charging. This source can be used for control of positively charged spacecraft potentials in sunlight and differentially charged spacecraft surfaces in shadow. This thesis investigates the dependence of the emitted ion current on several parameters: source temperature (power input), source bias potentials and potentials applied to simulated spacecraft geometries. Saturation currents of about $5.8 \mu\text{A}$ were measured at an extraction potentials of 100 Volts from a source of 0.317 cm^2 surface area with a power input of 18 Watts. The lifetime due to ion exhaustion indicate that this type of ion source may represent an effective charge control device for spacecraft.

EFFECTS OF CHARGE DENSITY RISE TIME UPON CERENKOV RADIATION

Perry M. Suttle - Lieutenant, United States Navy

B.S., Georgia Institute of Technology, 1982

Master of Science in Physics - June 1990

Advisor: J. R. Neighbours - Department of Physics

This study investigates the effects of different charge density rise times upon the magnitude of the Cerenkov radiation produced by a semi-infinite electron beam. The magnetic field pulses were generated for different rise times and relationships between the maximum magnitudes and their associated rise times were obtained. These were compared with theoretical relationships derived from a power series approximation. The generated results were close to those predicted by theory for short rise times at short radial distances. For longer rise times, the departure from theory was caused by the magnitude of the decay portion of the magnetic pulse. This effect could be mitigated at longer rise times by increasing the radial distance from the electron beam.

DETERMINATION OF SPEAR-1 ROCKET BODY POTENTIAL DURING HIGH-VOLTAGE EXPERIMENTS

Thurston Van Horn - Captain, United States Army

B.S., U.S. Military Academy, 1979

Master of Science in Physics - June 1990

Advisor: R. C. Olsen - Department of Physics

The Space Power Experiment Aboard Rockets (SPEAR) 1 payload was launched on December 13, 1987. It had a primary objective of providing guidelines in designing high-voltage (HV) systems for use in Low-Earth Orbit (LEO). The experiment consisted of 24 HV bias operations using two 20 cm diameter spheres attached to the rocket by booms. The SPEAR-1 rocket charged to substantial negative potentials during the flight when the spheres were biased positive with respect to the rocket. This thesis uses the electrostatic analyzer ion data to determine the charging response of the rocket body. The peak potential was reached during a 45 kV sphere bias sequence resulting in a -17.4 kV rocket body potential at 361 km altitude. The rocket body potential varied between 7 and 38 percent of sphere potential. Geomagnetic orientation, vice altitude, had greater effect on rocket body potential. The flight data also indicated that neutral gas emissions from the rocket attitude control system (ACS) triggered transient discharge currents that effectively grounded the rocket body potential. ACS firings resulted in an order of magnitude change in the rocket body potential.

EFFECTS OF LARGE DOSES OF HIGH ENERGY ELECTRONS ON A YBa₂Cu₃O₆+ HIGH TEMPERATURE SUPERCONDUCTOR

Gregory J. Wolfe

B.S.E., University of Michigan, 1977

Master of Science in Physics - December 1989

Advisor: X. K. Maruyama - Department of Physics

Two samples of YBa₂Cu₃O₆+ high temperature (93 K) superconductor samples were irradiated with 67 MeV electrons. Both samples were cut from the same parent, manufactured by the University of Houston. Radiation effects were studied by measuring resistance as a function of dose during exposure. The samples were exposed to dose up to 100 Mrads. One sample was irradiated at near room temperature, while the second sample was irradiated at 30 K, below the superconducting transition temperature. Resistance as a function of temperature data was obtained prior to and immediately after exposures for both samples. The samples evidenced little or no shifts due to radiation effects in either the normal state resistance or the transition temperature outside of measurement accuracies. Both samples showed evidence of overall crumbling and flaking of the leads, likely due to the continual thermal expansion and contraction of the different materials throughout the different measurements. These mechanical effects produced measurable changes in the normal state resistances. It is concluded that the YBa₂Cu₃O₆+ superconductor is significantly radiation-hard.

MEASUREMENTS ON LASER PRODUCED PLASMA USING FARADAY-CUPS

Duck-Sang Youn - Lieutenant Commander, Republic of Korea Navy

B.S., Korean Naval Academy, 1979

Master of Science in Physics - December 1989

Advisor: F. R. Schwrizke - Department of Physics

Experiments were performed on laser produced plasma from Lexan targets in a vacuum chamber at pressures of a few times 10^{-5} Torr. Plasma diagnostics was performed using Faraday-cups biased at -50 volts to +105 volts DC. In analyzing 460 oscilloscope traces pictures of Faraday-cup signals, the plasma expansion velocities measured was determined to be 1.25×10^7 cm/sec. At a distance of 10 cm from the laser-target impact point, the plasma electron temperature was determined from Faraday cup measurement to be about 2.4 ev. The plasma density was approximately 10^{13} cm $^{-3}$.

DIELECTRIC CHARGING AS A CATALYST TO THE FORMATION OF POTENTIAL BARRIERS ON SYNCHRONOUS ORBIT SATELLITES

Maude Elizabeth Young - Lieutenant, United States Navy

B.S., United States Naval Academy, 1984

Master of Science in Physics - March 1990

Advisor: R. C. Olsen - Department of Physics

This thesis postulates deep dielectric charging of exterior spacecraft dielectrics as a mechanism responsible for the sunlit charging event observed on the ISEE1 spacecraft. Deep dielectric charging can cause a negative potential to develop on the insulating surfaces of the spacecraft, resulting in the formation of a potential barrier capable of suppressing photo and secondary emissions. These events can lead to overall negative charging of the spacecraft. Calculations were made using in situ measurements from onboard the ISEE1 and the SCATHA spacecraft. The results indicate, within the accuracy of the data used, that this mechanism is a viable explanation for the ISEE1 charging event. This mechanism can be generalized to most synchronous orbit spacecraft.

**MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING
(ELECTRONIC WARFARE)**

**AIRBORNE DECM THREAT FILE REPROGRAMMING: ANALYSIS AND
RECOMMENDATION FOR THE BRAZILIAN AIR FORCE**

Geraldo Magela Batista - Lieutenant Colonel, Brazilian Air Force

B.S., Brazilian Air Force Academy, 1973

B.S., Federal Center of Technologic Education, Brazil, 1987

Master of Science in Systems Engineering - September 1990

Advisor: S. Hershey - Department of Electrical Engineering

The objective of this work is to outline rules for the implementation of Electronic Warfare Reprogramming Libraries (EWRL) in the Brazilian Air Force (FAB). First, a brief description of the structure and functions of the relevant branches of Brazilian Air Force will be presented. Second, why having a reprogramming process for airborne RADAR WARNING RECEIVERS (RWR) THREAT LIBRARIES is important at the current stage of EW development within the Brazilian Air Force. Third, based on the U.S. Navy's reprogramming process, a functional process, flow chart and responsibilities for the development and distribution of EWRL will be recommended. Finally, an execution process will be outlined.

**STATISTICAL ANALYSIS OF BACKGROUND IR EMISSION IN THE
3 - 5.6 μm AND 8 - 14 μm REGIONS**

Sefik Bayar - LTJG, Turkish Navy

B.S., Turkish Naval Academy, 1983

**Master of Science in Systems Engineering (Electronic Warfare) -
December 1989**

Advisor: D. D. Cleary - Department of Physics

The amplitude distributions of the sky and sea background noise in the 3 - 5.6 μm and 8 - 14 μm spectral regions are analyzed. These background scenes were obtained with an AGEMA 780 Thermovision sensor and recorded with AGEMA TIC - 8000 data acquisition system. The amplitude distributions of 3 - 5.6 μm clear sky, 3 - 5.6 μm cloudy sky, and 8 - 14 μm sea background noise sources obey Gaussian distributions. A Gaussian amplitude distribution does not provide a good fit to the observed 3 - 5.6 μm sea background data and the 8 - 14 μm clear sky background. Scene contamination may have caused the 3 - 5.6 μm sea background to deviate from a Gaussian distribution. In addition, the amplitudes of the 8 - 14 μm clear sky background fall into the non-linear portion of the dynamic range of the scanner. As a result, no conclusion is made regarding the parent distributions for 3 - 5.6 μm sea background or the 8 - 14 μm clear sky background.

**REDUCING THE SUSCEPTIBILITY OF LOW SPEED/LOW MANOEUVRABILITY
AIRCRAFT TO INFRARED MISSILE KILLS**

Hock Teck Chia - Major, Republic of Singapore Air Force

B.Eng., University of Singapore, 1980

Master of Science in Systems Engineering - December 1989

**Advisors: A. W. Cooper & R. E. Ball - Electronic
Warfare Academic Group**

Low speed/low manoeuvrability aircraft are currently quite susceptible to being killed in attacks by the ubiquitous infrared missiles. A theoretical analysis applied to an encounter simulation seems to indicate that it is possible to use the infrared jammer to defeat second generation infrared missiles. The theoretical analysis of a simplified case of a conical scan reticle with frequency modulation jamming leads to expressions for the target's position, as seen by the missile seeker, under no-jamming and under infinitely-powerful-jamming conditions. The intermediate-power case is dealt with by numerical analysis for a selected, non-optimal situation, as the closed form solution is not immediately apparent. The analysis indicates successful jamming in the situation studied. In the scenario where the infrared missile is an almost continuous threat during the aircraft's flight, infrared jammers and low visual signature paints, and perhaps low infrared signature paints, are short-term solutions that are potentially useful in increasing the survivability of these aircraft by reducing their susceptibility to infrared missile kills.

**COMPUTER SIMULATION OF A LASER DESIGNATOR IN
THE OPERATIONAL ENVIRONMENT**

**Dong-ho Choi - Lieutenant, Republic of Korea Navy
B.S.E.E., Korean Naval Academy, 1982**

Master of Science in Systems Engineering - December 1989

Advisor: E. A. Milne - Electronic Warfare Academic Group

This thesis presents a computer simulation program designed to predict the performance of a laser designator in operational environment. It uses aspects of Fourier optical theory, atmospheric modulation transfer function, atmospheric transmittance, and turbulence to analyze the spot size and the power on a target. The guidance system requires the specific power and spot size on a target to track it. So the optimum system for special military purpose can be chosen by the output of this program for a particular atmospheric condition.

**CIRCUIT MODELS FOR A MILLIMETER-WAVE SUSPENDED-MICROSTRIP
LINE DISCONTINUITY**

**Won Tae Jin - Major, Republic of Korea Army
B.S., Korea Military Academy, 1981**

Master of Science in Systems Engineering - September 1990

**Advisor: H. A. Atwater - Department of Electrical and
Computer Engineering**

The goal of this work is to develop an equivalent circuit model for a typical discontinuity in shielded suspended substrate line, in particular, the step-change in width. This circuit model is needed for use in CAD analysis of microwave systems using the suspended stripline transmission mode.

**REFRACTIVE CONDITIONS IN ARABIAN SEA AND THEIR EFFECTS
ON RADAR AND ESM OPERATIONS**

**Kamran Khan - Lieutenant Commander, Pakistan Navy
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**Master of Science in Systems Engineering (Electronic Warfare)
September 1990**

Advisor: K. L. Davidson - Department of Meteorology

This thesis examines how atmospheric conditions influence the performance of radar and Electronic Warfare systems. Of particular interest is the frequency of occurrence of various types of ducts in the Arabian Sea which is presented. Potential tactical advantage through better knowledge of ducting conditions is also examined. EREPS and IREPS, PC based programs for evaluating the atmospheric effects on radio systems, are addressed. An application of the above is the Airborne Microwave Refractometer (AMR) installed in an aircraft which samples the above conditions and provide an assessment of the meteorological profile of the atmosphere. The proposed installation in Pakistan navy P-3C aircraft is discussed.

TACTICAL EO/IR SYSTEM FOR GROUND FORCES

**Hyung Suk Kim - Captain, Republic of Korea Army
B.S., Korea Military Academy, 1985**

**Master of Science in Systems Engineering (Electronic Warfare)
September 1990**

Advisor: E. A. Milne - Department of Physics

This thesis describes the tactical EO/IR system requirements and characteristics for the Republic of Korean Army. Many key ideas of these are centered on rough terrain condition, severe weather condition and tactical usage of EO/IR system in Korean peninsula. And finally, the future trends of ground tactical EO/IR system and some recommendations for Korean Army are presented.

DEFENCE OF SHIPS AGAINST ANTI-SHIP MISSILES
Ramesh Kumar - Lieutenant Commander, Indian Navy
B.Sc, Jawahar Lal Nehru University, 1978
Master of Science in Systems Engineering (Electronic Warfare)
September 1990
Advisor: E. A. Milne - Department of Physics

This thesis discusses the Anti-Ship Missile problem and explores the various options available for countering the Anti-Ship Missile. Special emphasis has been given to the chaff solution for defeating the Anti-Ship Missile. A program has been written to enable the testing of the effectiveness of the medium range and close range chaff deployed in conjunction with various conditions of wind and various ship's courses. The program can be used to determine the best solution for deploying the medium range chaff given the known parameters such as detection ranges and probable wind conditions. The program was run with medium range chaff deployed in the default position and the wind's course was varied through 180 degrees. For each of the courses of the wind 3 wind speeds were tried. The ship's course was also varied through 360 degrees for each of the winds courses in 45 degree steps. The seduction chaff was automatically deployed by the program.

ANALYSIS OF LOSS FOR INDUCTIVE STRIPS IN FINLINE
Levent Kurtoglu - Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1984
Master of Science in Systems Engineering (Electronic Warfare)
September 1990
Advisor: J. Knorr - Department of Electrical and
Computer Engineering

This thesis introduces the effect of the loss to the homogeneous finline strip model. The expressions for the Quality Factors associated with the ohmic losses for inductive strips in homogeneous finline are derived and included in the CAD compatible circuit model in terms of the finite Q inductances. It is shown that the lossy circuit models more accurately predict the experimental response of an X band finline filter.

VALIDATION OF THE SCHWARTZ AND HON ALGORITHM AT LOW
GRAZING ANGLES
Gregory M. Lawler - Lieutenant, United States Navy
B.A., United States Naval Academy, 1982
Master of Science in Systems Engineering - September 1990
Advisor: A. W. Cooper - Department of Physics

An experienced validation of the Schwartz-Hon computer code for emissivity of the rough sea surface in the grazing angle region was carried out using an AGEMA 780 thermovision radiometric sensor. The experimental measurements were made in Monterey Bay using a meteorological suite mounted on the Research Vessel Point Sur, with coordinated radiosonde launches. Predicted sea surface radiance was computed from reflected sky radiance and thermal sea emission, using the Schwartz-Hon algorithm for sea emissivity and equivalent specular incidence angle. PC-TRAN in radiance mode was used to compute sky radiance, and compared with AGEMA measurements. AGEMA sea radiance measurements were compared with the model predictions as a function of observation angle and were found to agree within 8% for elevation angles from zero to 5 degrees. PC-TRAN sky radiance computations for the grazing angle region agreed with AGEMA measurements within approximately 12%.

**ASSESSMENT OF THE EFFECTS OF REFRACTIVE CONDITIONS ON ELECTRONIC
WARFARE IN CENTRAL AMERICA**

**Mauricio Gaviria Maldonado - Lieutenant, Colombian Navy
Master of Science in Systems Engineering (Electronic Warfare)
September 1990**

Advisor: K. L. Davidson - Department of Meteorology

This thesis presents a study of the atmospheric refractivity conditions in the oceanic area around Central America and a description of the possible propagation effects on surveillance systems. The basic principles of atmospheric refraction are presented along with the techniques used to determine the occurrence of atmospheric ducts and to characterize the type of refractive profiles occurring at a station. Radiosonde data collected by coastal stations in the area were used to establish refractive conditions.

CLOSED LOOP POLE PLACEMENT AND COST ANALYSIS

**Joel C. Reaves - Lieutenant, United States Navy
B.S., United States Naval Academy, 1981
Master of Science in Electronic Systems Engineering - December 1989
Advisor: G. J. Thaler - Department of Electrical and
Computer Engineering**

A study was made of Type I linear control systems, and cost functions, the integral of error squared, and the integral of error squared plus a weighting factor times the control effort squared. The effects of cost function minimization of characteristic root movement for specific third and fourth order systems are investigated to determine if they move into any recognizable patterns. The effects on the unit step response of the minimized systems are also determined. Performance of these minimized systems in the presence of saturation is evaluated specifically to determine if the system response can be improved beyond that of function minimization alone. By minimizing the integral of error squared, IES, the characteristic roots do tend to the pattern of the IES standard form. Also, by weighting the control effort while minimizing the system error, the characteristic roots do tend toward the Butterworth pattern. Systems designed in this manner do perform better in the presence of saturation.

**RADAR TARGET CLASSIFICATION BY NATURAL RESONANCES:
SYSTEM ANALYSIS**

**Peter C. Reddy - Captain, United States Marine Corps
B.S.A.E., University of Virginia, 1984
Master of Science in Systems Engineering (Electronic Warfare)
September 1990
Advisor: M. A. Morgan - Department of Electrical and
Computer Engineering**

This thesis examines the system implementation considerations of a resonance-based radar target classification system. The basis of the system is the aspect and excitation independent property of electromagnetic scattering from a conducting body. Such a system consists of two components: pole extraction and annihilation filtering. The algorithms investigated here for these purposes are the Cadzow-Solomon pole extraction algorithm and the K-Pulse annihilation filter. Additionally, an aspect-dependent annihilation filter based on an inverse ARMA model is introduced. The procedures are applied to noise polluted synthetic data, as well as scattering data collected for a thin-wire and silver coated 1/72 scale model aircraft.

USE OF AN EXTENDED KALMAN FILTER

Juan Jose Sanchez - Lieutenant, Venezuelan Navy
Master of Science in Systems Engineering (Electronic Warfare)
September 1990

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

The error introduced by the DF accuracy of three Direction Finding equipments used on board two surface units providing bearing measurements, is used to evaluate the performance of the ESM systems using the Kalman Filter equations. The estimation process is evaluated as the error introduced in the DF accuracy of the ESM systems is increased. The process is conducted with three different maneuvers involving a change in course of 0, 45 and 90 degrees. This thesis shows how the maneuver detection algorithm stopped working when the DF noise exceeded 4.6 degrees for the second scenario and 9.6 degrees for the third scenario.

THE DESIGN OF BROADBAND RADAR-ABSORBING SURFACES

Go Han Suk - Lieutenant, Korean Navy
B.S., Naval Academy Korea, 1983
Master of Science in Systems Engineering In Electronic Warfare
September 1990

Advisor: H. A. Atwater - Electrical and Computer Engineering

There has been a growing and widespread interest in radar-absorbing material technology. As the name implies, radar absorbing materials or RAM's are coatings whose electric and magnetic properties have been selected to allow the absorption of microwave energy at discrete or broadband frequencies. In military applications low radar cross section (RCS) of a vehicle may be required in order to escape detection while a covert mission is being carried on. These requirements have led to the very low-observable or stealth technology that reduces the probability of detection of an aircraft. The design of radar absorbing materials is limited by constraints on the allowable volume and weight of the surface coating, and it is difficult to design a broadband radar absorbing structure in limited volume. This thesis investigates the use of lossy dielectric materials of high dielectric permittivity in multi-layer composites for the production of low radar cross section (RCS). The analysis is done by computing the plane wave reflection coefficient at the exterior surface of the composite coating by means of a computer program which selects layer parameters which determine low reflection coefficients for electromagnetic radiation under constraint of limited layer thickness as well as maximum frequency bandwidth.

ELECTRONIC COUNTERMEASURES (ECM) AND ACOUSTIC COUNTERMEASURES SUPPORTED PROTECTION FOR MERCHANT SHIPS AGAINST SSM/ASM MISSILES AND MINES

Bo L. Wallander - Lieutenant Commander, Royal Swedish Navy
Swedish Naval Academy, 1974
Swedish Staff and War College, 1987
Master of Science in Systems Engineering (EW) and
Engineering Acoustics - December 1989
Advisor: R. L. Partelow

The necessity for merchant ship self protection has become more and more obvious during recent years. This thesis will investigate the threat (missiles and mines) and associated counter-measures that might be installed to provide a reasonable degree of protection. The results indicate that it is possible to get protection against a sea-skimming missile with a combination of ECM and ESM deployed aboard the ship. For protection against the mine threat, a sonar is designed in order to give the ship enough warning time to make an avoiding maneuver. The sonar investigation indicates the difficulty in designing a sonar that can fulfill all design objectives year-round in a complex acoustic environment.

SPECIFICATION OF DIFFICULT TO TEST RADAR PERFORMANCE

Chen-Kuo Yu - Commander, Republic of China Navy

B.S., Naval Academy of Republic of China, 1976

Master of Science in Systems Engineering (Electronic Warfare)

September 1990

**Advisor: H. M. Lee - Department of Electrical and
Computer Engineering**

In order to obtain detection range requirement of a new radar system, a computer simulation model is developed to evaluate the capability of the radar in an anti-air defense operation. Since the anti-ship missile is not available for test and evaluation, a technique to specify the performance requirement and design the test and evaluation plane using an airplane is developed. The effects of the propagation environment are also discussed.

**MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(ASW)**

THE IMPACT OF HUMAN FACTORS ON DECISION MAKING IN COMBAT

**James S. Couey - Captain, United States Army
B.S., Presbyterian College, 1979
and**

**Randal A. Dragon - Captain, United States Army
B.S., James Madison University, 1979**

Master of Science in Systems Technology - June 1990

Advisor: S. H. Parry - Department of Operations Research

This thesis identifies those human factors which impact on a commander's decision in a tactical combat environment. Various models for categorization are discussed. The study argues that in order to establish clear casual/effect relationships between human factors and battle outcome, concentration of analytical research must focus on first order effects. Two categorical judgement surveys in the form of questionnaires are developed. Results from the surveys are transformed to interval scales. The first survey is exploratory in nature and allows respondents to apply 27 endogenous factors within a generic tactical context. The second survey presents four specific tactical scenarios in which the top seven factors identified in the first survey can be applied. Respondent selection for the first survey represented the four military services while respondent selection for the second survey was limited to Army officers. The study concludes that the top seven factors are: Leadership, Training/Experience, Initiative, Discipline, Cohesion, Morale, and Will/Motivation. The rank order and scaled magnitudes of these factors are found to be scenario dependent.

FACTORS INFLUENCING RAPID PROTOTYPING INNOVATION IMPLEMENTATION: A DESCRIPTION MODEL

**Tammy L. Davis - Lieutenant, United States Navy
B.S., United States Naval Academy, 1985**

Master of Science in Systems Technology - March 1990

Advisor: R. A. McGonigal - Department of Administrative Science

This thesis examines the factors that influence rapid prototyping innovation implementation. Research was conducted to develop a qualitative, descriptive model of factors influencing user acceptance and organization implementation. The model reflected a review of the literature on innovation acceptance, implementation of change, human factors in technology transfer, and organizational development; a review of related Navy-specific findings and the elements of rapid prototyping; a case study of Inter-National Research Institute's Joint Operational Tactical System evolution as a real world example; and interviews and correspondence with personnel representing "players" in the development and utilization process. This model is useful in structuring thinking about the problems of innovation implementation, identifying areas where future research on the acceptance process may have the greatest impact, and may be extended to provide direction for timely integration of future innovative efforts through rapid prototyping.

EFFECT OF DOCTRINAL DIFFERENCES ON NATO C2

**Kenneth P. Dzierzanowski - Captain, United States Army
B.S., United States Military Academy, 1981**

Master of Science in Systems Technology - June 1990

Advisor: M. G. Sovereign - Department of Operations Research

The warfighting doctrines of NATO's five national armies, which are deployed in central Europe against the Warsaw Pact, are examined with emphasis on coalition warfare. NATO's warfighting doctrine is explored with particular attention to the military and political aspects of coalition warfare. Selected NATO command, control, and consultation issues, including synchronization and coordination, are identified and examined. The doctrines of these five national armies are not fully compatible. Warfighting doctrines which are not compatible increase the vulnerability of multi-national unit boundaries and do not contribute to the overall impression of deterrence. Concepts to improve NATO's deterrent and warfighting capabilities are presented. These concepts include approaching incompatible national doctrines as a coordination issue. If NATO strengthens its coordination mechanisms, both the coalition's peacetime deterrent efforts and wartime capabilities will be enhanced.

THE ISRAELI DEFENSE FORCES: AN ORGANIZATIONAL PERSPECTIVE

Matthew J. Green - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Systems Technology - March 1990

**Co-Advisors: C. R. Jones - C3 Academic Group & R. H. Magnus -
Department of National Security Affairs**

The author traces the organizational growth and change within the Israeli Defense Forces (IDF) over its 40-year history. A model is offered which depicts a military organization as an open system embedded within a changing environment. Selected inputs to this organizational system are shown to affect organizational structure and, in turn, the combat capabilities of the force. The author uses the five major Arab-Israeli wars as critical junctures in examining the IDF's organizational history. The IDF is shown to have a willingness and ability to adapt to changing environmental factors. This capacity is determined to be a major reason for the IDF's long military dominance in the region. The author concludes with an analysis of the IDF's unique organizational adaptability.

ACQUISITION GROUP DECISION SUPPORT SYSTEM

Kevin P. Haupt - Captain, United States Air Force

B. S., Norwich University, 1984

Master of Science in Systems Technology - June 1990

Advisor: D. A. Lacer - C3 Academic Group

Military system acquisition management decisions can be both untimely and uninformed, according to the author, due to the adverse effects of communication breakdown and filtering of information. An acquisition group decision support system (AGDSS) defined in this thesis, seeks to maintain acquisition team integrity and provide the necessary information processing capacity to mitigate the impact of these effects. The combination of such key technologies as local area networks, word processing, graphics, data base management, and video conferencing, is employed, which can free acquisition team members of mundane paperwork and afford them extraordinary decision making capabilities. These capabilities promise to result in more timely and better informed decisions. An example is provided to illustrate the application of an AGDSS to an acquisition-related problem and to show the benefits that can be derived from the output of the AGDSS. Finally, a system-level specification describing the performance and interface requirements is presented.

COMMAND AND CONTROL ARCHITECTURE FOR RECONNAISSANCE AND COUNTERRECONNAISSANCE IN THE U.S. ARMY ARMOR AND MECHANIZED INFANTRY TASK FORCE

James B. Henderson - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Systems Technology - March 1990

Advisor: C. R. Jones - C3 Academic Group

The author presents an analysis of reconnaissance and counterreconnaissance missions in the U.S. Army armor and mechanized infantry task force. An introduction to reconnaissance and counterreconnaissance provides background information essential to the analysis of each mission. The impact of information processing within the task force and its effect on mission execution is discussed. A systematic approach to mission, or task, analysis using four task variables (task characteristics, task environment, inter-unit task interdependence, technology) identifies the uncertainty in the task and the subsequent impact on information processing. An analysis of reconnaissance and counterreconnaissance using the four variables reveals the uncertainty in each task and its effect on the information processing capability of the task force. A unique command and control architecture is developed for each task which addresses the uncertainty in the task and facilitates information processing within the task force.

ARCHITECTURE SELECTION FOR DEPLOYABLE LOCAL AREA NETWORKS

David P. Hunninghake - Captain, United States Air Force

B.S., Washburn University, 1984

and

Bradley K. Ashley - Captain, United States Air Force

B.S., University of Georgia, 1985

M.S., Golden Gate University, 1987

Master of Science in Systems Technology - March 1990

Advisor: T. A. Schwendtner - Department of Electrical and Computer Engineering

The United States Air Forces' Headquarters Tactical Air Command (TAC) Communications-Computers staff provides guidance to TAC functional users on the procurement and use of Local Area Networks (LANs) in a deployed environment. Deployable systems may be defined as those systems designed to be transported away from their normal base for semi-fixed or mobile tactical missions. Major deployed LAN concerns include issues related to transmission media, protocols, topology, and transportability/survivability. The objectives of this thesis are to: (1) review the basics of LAN technology, (2) identify unique requirements of deployed LANs, (3) make recommendations for the proper selection of deployable LAN architectures. This thesis presents many of the complex and interrelated technical factors of LANs such as media, topology, and protocols. Selecting the proper LAN architecture cannot be done by using a simple algorithm. Many factors must be evaluated, as a whole, by an expert in the technology. There is no single answer to all military deployed LAN requirements; however, some general recommendations can be made. The most important recommendation made is to rely on a LAN expert from design through fielding of a deployable LAN.

OPERATIONAL PROCEDURES FOR POWERING UP, POWERING DOWN, AND CONFIGURING THE QUALIFICATION MODEL OF THE FLTSATCOM SATELLITE

Hank Lawson - Major, United States Marine Corps

B.S., United States Naval Academy, 1975

Master of Science in Systems Technology - September 1990

Advisor: D. C. Boger - Department of Administrative Science

The engineering qualification model of the FLTSATCOM satellite was donated to the Naval Postgraduate School (NPS) on 1 August 1990 by the Navy Space Systems Division and TRW Space and Technology Group. The satellite is housed in Halligan Hall at NPS and is to be used for instructional laboratories and research. With the acquisition of this spacecraft, a course was established on spacecraft testing with the intent of using the qualification model as a lab device. The course requirement calls for the ability to power up, power down, and configure the satellite within a reasonable time frame. The objective of this thesis is to produce a single source implementation guide which will fully document the step-by-step procedures for powering up, powering down, and configuring the qualification model of the FLTSATCOM satellite in its current modified configuration.

THE ROLE OF STRATEGIC PLANNING IN THE EVOLUTION OF COMMAND & CONTROL SYSTEM

Richard L. Mallick - Captain, United States Air Force

B.S., Grove City College, 1983

Master of Science in Systems Technology - March 1990

Advisor: F. M. Teti - Department of National Security Affairs

This thesis examines the role that strategic planning plays in the evolution of Command Control (C2) systems by defining both C2 and strategic planning and showing the interfaces between them. It goes on to show how the view of the threat in the years to come influences the implementation of C2 systems. Furthermore, the author challenges the traditional strategic thought on threat assessment which views the threat primarily as a massive Warsaw Pact attack on Central Europe or an all-out Soviet nuclear attack. The future threat, projected ten to twenty years out is examined and expanded to include more likely scenarios the U.S. military may face including: drug trafficking, low intensity conflict in the Persian Gulf, and ballistic missile proliferation. From these emerging threats, the author recommends what C2 system technology the Department of Defense (DOD) should pursue.

EMPLOYMENT AND COMMAND AND CONTROL FOR THE NON-LINE-OF-SIGHT (NLOS) MISSILE SYSTEM

Edward D. McCoy - Captain, United States Army

B.S., United States Military Academy, 1980

Master of Science in Systems Technology - June 1990

Advisor: LTC W. J. Caldwell - Department of Operations Research

The author describes the employment and command and control of the Non-Line-of-Sight (NLOS) missile system. A history of the system portrays NLOS as a weapon system still in the early stages of development. A detailed description depicts NLOS as an application of fiber optic technology enabling the engagement of helicopters and ground targets beyond visual range. The plan to organize and employ NLOS in separate units (anti-air and anti-tank) at the maneuver brigade in the context of its employment as a dual capable system at the maneuver brigade level and in the context of a definition of command and control. Early command and control testing for the NLOS system is discussed and some of the results of that testing provides the basis for the following conclusions: The employment of NLOS at the maneuver brigade level should work with the exception of NLOS-AT (anti-tank) units being used to engage helicopters; the employment of NLOS-AD (air defense) in the air role is heavily contingent on the development and successful integration of masked target sensors into the Forward Area Air Defense Command, Control and Communications (FAADC21) system; and the lack of weapon system hardware and proposed automated command and control systems for the NLOS system precludes a definitive evaluation of command and control at this time.

AN OPERATIONAL EVALUATION OF THE ARMY TACTICAL COMMAND AND CONTROL SYSTEM

Michael J. McMahon - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Systems Technology - June 1990

Advisor: C. R. Jones - C3 Academic Group

This thesis presents an approach to analyzing the effectiveness of the Army Tactical Command and Control System currently under development. ATCCS is an automated system composed of hardware, software, and communications that will allow the various battlefield functions to be accomplished more efficiently, and with greater interoperability and survivability than current command and control systems. Because effective models do not exist to allow for analysis of C2 systems in an integrated tactical environment, the methodology presented in this thesis focuses on importing certain measures of performance, established by the various systems requirements documents, into Janus(A), a combat model used to simulate combat between units of battalion size and smaller. The alternative C2 systems are placed in support of an attack helicopter deep strike in high-intensity European environment. The results of the modeling effort show a significant advantage in terms of survivability of the helicopters when supported by ATCCS in the command and control functions.

DETERMINANTS OF THE EFFECTIVENESS OF SITUATION ESTIMATION

James D. McMullin - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Systems Technology - June 1990

Advisor: C. R. Jones - C3 Academic Group

This thesis contains a discussion of the estimate of the situation as a decision-making process. The author provides a background on the estimate of the situation as a process and in individual, group and organizational decision making. An information-processing model for an organization demonstrates the need for a match between information-processing requirements and capabilities. Information-processing requirements include factors from technology, inter-unit dependence, and the environment. Information capabilities consist of unit structure and integrating mechanisms. As the information-processing requirements approach a high level of uncertainty, the capabilities must match. The appropriate decision-making procedure to use varies with the change in uncertainty. The estimate of the situation procedure works well in highly uncertain situations, but is very time intensive. Alternate methods can accommodate reduced uncertainty or reduced time available. Evaluations of staffs may not consider the context or situation in which the staff operates. The situational factors incorporated in a staff evaluation are useful in an accurate assessment.

SATELLITE MANEUVER EVALUATION TOOL

Carlos Ismael Noriega - Captain, United States Marine Corps

B.S. University of Southern California, 1981

Master of Science in Systems Technology and Computer Science - September 1990

Advisors: H. H. Loomis - Space Systems Academic Group &

M. J. Zyda - Department of Computer Science

When first introduced to orbital mechanics, students often experience difficulty in visualizing a satellite's actual path through space. The Satellite Maneuver Evaluation Tool (SMET) seeks to alleviate that problem. SMET is a three-dimensional color graphics simulation of satellites in flight. It allows a student to interactively modify a satellite's orbital parameters and see the effects as the satellites' positions are updated continuously with respect to time. The user can change parameters by defining a maneuver or by directly entering a change through keyboard or dial inputs. SMET offers the user the capability to demonstrate difficult concepts, as well as a method to simulate actual satellite maneuvers. Instructors can videotape SMET sessions for classroom demonstrations. Instantaneous images can also be saved for redisplay or for printout. This thesis provides a background on the mathematical formulas modeled by SMET. It also includes a detailed user's guide for SMET.

FIRE SUPPORT COORDINATION: A SYSTEM ARCHITECTURE PERSPECTIVE

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B.A., Fairfield University, 1982

Master of Science in Systems Technology - March 1990

Advisor: C. R. Jones - Department of Administrative Science

The purpose of this thesis is twofold: first is to describe the current Marine Corps fire support system as an overall architecture and the second is to provide teaching materials for the Joint C3 curriculum. The emphasis will be to identify and illustrate the various command, control and coordination procedures that are evident throughout the system. The system architecture described will provide a foundation from which the student will be required to design their own conceptual architecture. The command and control architecture of the fire support system is presented. A detailed analysis of the underlying C2 processes of the structure is conducted. A case is developed that will encourage the student towards the application of C2 concepts and principles. The author concludes with a description of methods used to evaluate an architecture.

C3 SYSTEMS ENGINEERING: A PRIMER

John S. Purnell - Lieutenant, United States Navy

B.A., University of California, Berkeley, 1984

Master of Science in Systems Technology - March 1990

Advisor: D. Lacer - C3 Academic Group

The components of a command, control and communications (C3) system have evolved from highly sophisticated forms of electronic hardware and software innovations. Modern C3 systems such as the Joint Tactical Information Data System (JTIDS) or Airborne Warning And Control System (AWACS) incorporate a wide assortment of computers, CRT displays, communications equipment and data processing systems. These systems are developed and integrated through the means of highly proficient system engineering processes. This thesis addresses the elements of basic creative and design processes that contribute to system engineering methodology. This thesis discusses the various stages of the system engineering process which serve to integrate the design and development of such large scale systems. A case study: "CINCCENT Ground Mobile Command Post", is presented as an example of the system engineering process.

DESIGN RESTRICTIONS AND LICENSING FOR PETITE AMATEUR NAVY SATELLITE (PANSAT)

**Robert R. Rowsey - Captain, United States Marine Corps
B.S., United States Naval Academy, 1984
Master of Science in Systems Technology (Space Systems
Operations) - September 1990
Advisor: R. Panholzer - Space Systems Academic Group**

The small inexpensive Petite Amateur Navy SATellite (PANSAT) is the Naval Postgraduate School (NPS) Space Systems Academic Group's first experience with real-time space operations. Propelled by success of PANSAT, NPS will follow this project with more complex space systems such as ORION. This thesis discusses the general and specific design considerations and constraints encountered during the design of PANSAT, along with providing descriptions of the satellite's various subsystems. The study also addresses the problems and procedures associated with obtaining a license/frequency assignment for PANSAT. Three viable licensing options, an amateur, a military and an experimental option are presented. The thesis also includes a detailed description of the national and international frequency regulatory agencies, for better understanding of the licensing procedures.

SDI SATELLITE COMMUNICATIONS WAVEFORM ANALYSIS

**Carlos C. Solari - Captain, United States Army
B.S., Washington and Lee University, 1979
and
Harold L. Sommer - Captain, United States Air Force
B.S., United States Air Force Academy, 1983
Master of Science in Systems Technology - June 1990
Advisor: D. A. Lacer - C3 Academic Group**

Communications waveforms for the Strategic Defense System (SDS) must be robust to facilitate communications in a hostile nuclear environment. Proposed waveform design efforts are driven by three top-level factors: the nominal propagation environment, the threat, and the user data rate requirements. No attempt is made by the authors to validate a waveform, but rather to identify the general signalling process, the basis for waveform selection, and the impact of the high level system drivers. The authors concluded that in light of the dynamic nature of the proposed architecture and stringent communication requirements that the design emphasis should be placed on a common threat estimate, the use of proven technology, and not tied specifically to any battle management/C3 architecture data rate requirements. This approach results in proposed waveforms that can be compared under the same conditions, and ultimately in a waveform that will be uniformly accepted.

COMBAT MODELING FOR COMMAND, CONTROL, AND COMMUNICATIONS: A PRIMER

**Joel Thomas Swanson - Lieutenant, United States Navy
B.S., Colorado School of Mines, 1983
Master of Science in Systems Technology - March 1990
and
John Herbert Gibson - Captain, United States Air Force
B.A., Point Loma College, 1977
Master of Science in Systems Technology - June 1990
Advisor: W. P. Hughes - Department of Operations Research**

This thesis is a primer for a combat modeling course for Joint Command, Control and Communications (C3) students at the Naval Postgraduate School. It provides the students with a single document which ties together the concepts of several modeling experts pertinent to C3. The thesis examines various aspects of combat models and introduces some of their functions, applications, and results. Areas included in the primer are: combat theory and definitions or command and control reflected in that theory; modeling techniques; measures of effectiveness; history of naval modeling; and a survey of current modeling efforts, such as simulation, Chaos Theory, and Decision Support Aids. The thesis introduces basic concepts and identifies readings from which those concepts were extracted. It does not teach the students to develop combat models, though it gives insight into how the application affects proper model selection.

**AN EVALUATION AND COMPARISON OF THE ARMY'S ACQUISITION PLANS FOR TWO TACTICAL
COMMAND AND CONTROL COMMUNICATIONS SYSTEMS: MOBILE SUBSCRIBER
EQUIPMENT AND SINGLE CHANNEL GROUND AND AIRBORNE RADIO SYSTEM**

**Denise F. Williams - Captain, United States Army
B.S., Austin Peay State University, 1982**

and

**Ralph I. Ebener, Jr. - Captain, United States Army
B.S., Massachusetts Institute of Technology, 1981**

Master of Science in Systems Technology - June 1990

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

This thesis evaluates the Acquisition Plans of two US Army Command, Control, and Communications (C3) systems: Mobile Subscriber Equipment (MSE) and the Single Channel Ground and Airborne Radio System (SINCGARS), both of which are components of the Army Tactical Command and Control System (ATCCS). The study examines the defense acquisition process through the comparison of the Acquisition Plans and lessons learned for these two programs, and determines if there is an optimal strategy for the Army to use when acquiring C3 systems. An analysis of the strengths and weaknesses of the two Acquisition Plans, and an evaluation of the similarities and differences of the two programs, concludes that the MSE Acquisition Plan proved more successful than its SINCGARS counterpart because of its Non-Developmental Item approach. This study recommends maximum use of the NDI strategy for acquiring C3 systems whenever possible.

THE SPACE SHUTTLE: AN ATTEMPT AT LOW-COST, ROUTINE ACCESS

Jeffery D. Wonch - Lieutenant, United States Navy

B.S., University of Michigan, 1983

**Master of Science in Systems Technology (Space Systems
Operations) - September 1990**

Advisor: D. A. Lacer - C3 Academic Group

This thesis examines the Space Shuttle's purpose of low-cost, routine access to space and how the lessons learned during the Space Shuttle program have affected the thinking on new heavy-lift launch systems. The thesis objective is to show the Space Shuttle was an attempt at developing a routine, low-cost access to space but, because of Shuttle-unique capabilities, cost-effective operations may never be realized with the Shuttle system. The Space Shuttle concept definition is addressed and the impact on design by DOD influence. The Space Shuttle developmental history is presented, and how budgetary constraints, coupled with NASA's desire to build a low-cost system resulted in over-runs in schedule and costs. The thesis looks at the operational period of the Space Shuttle, the use of Government subsidies to keep the price to a Shuttle launch artificially low, and the difficulties experienced by NASA in maintaining the planned launch schedule. The Challenger accident resulted in restructuring of U.S. space policy as well as how the Shuttle will be used in the future. In conclusion, lessons learned from the Space Shuttle program are presented that the next generation of space transportation systems can build upon.

**TOWARD A NATIONAL SPACE WARFIGHTING ARCHITECTURE: FORGING
A FRAMEWORK FOR DEBATE ABOUT SPACE-BASED OPERATIONAL
AND TACTICAL COMBAT SUPPORT**

**Robert O. Work - Major, United States Marine Corps
M.S., University of Southern California, 1980**

**Master of Science in Systems Technology (Space Systems
Operations) - September 1990**

Advisor: C. R. Jones - C3 Academic Group

The primary objective of this thesis is to propose a template for a National Space Warfighting Architecture (NSWA). The template is intended to fill the void that exists between national security space policies and the services' space warfighting plans. As such, it will provide a unifying framework for follow-on discussions and debate about the proper direction of space-based operational and tactical combat support. In support of this objective, this thesis aims to: provide the proper focus for the architecture; identify the key conceptual ideas that should drive its development; establish a common vocabulary among managers of the Space-based Strategic Reconnaissance/Surveillance Program, service space support officers, and terrestrial warfighters; develop a logical and meaningful architectural organizational approach; facilitate the comparison between space-based and terrestrial-based combat support systems; and show how the NSWA fits within the larger framework of the National Space Program.

**MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(C3)**

A FRAMEWORK FOR UNDERSTANDING THE STRATEGIC DEFENSE INITIATIVES' SOFTWARE DEBATES

Reginald C. Adams - Captain, United States Air Force

B.S., Mississippi Valley State University, 1984

Master of Science in Systems Technology - June 1990

Advisor: D. Lacer - Department of Joint, Command, Control, and Communications

On March 23, 1983, then-president Ronald Reagan challenged a group of engineers and scientists to make nuclear weapons "impotent and obsolete." This challenge led to the beginning of a new era in space technology and strategic defense, thus creating the Strategic Defense Initiative (SDI), better known as "Star Wars." By 1984, several studies had begun to show that software in conjunction with Battle Management/Command, Control, and Communications techniques would play a major role in determining the effectiveness of the SDI. The results from these studies caused numerous controversial debates on the reliability, dependability, and trustworthiness of the software. This thesis provides a framework for understanding the complexities of the SDI software and points out some of the major issues involved in the software debates. The structure for this thesis is based on presenting the opinions of various computer scientists and engineers, indicating the issues that are controversial and those that have been defined as a necessity for the SDI program. One of the major highlights is the SDI summary chart that provides the reader with a very brief narrative of each individuals' opinion on the software issues discussed in this thesis.

ELECTRONIC COMMUNICATION SYSTEMS & THE FREQUENCY DOMAIN:

AN ILLUSTRATED PRIMER FOR C3 STUDENTS

Bruce Kevin Babcock - Captain, United States Air Force

B.S.E.E., University of Central Florida, 1979

Master of Science in Systems Technology - June 1990

Advisor: M. D. Weir - Department of Mathematics

This thesis is a tutorial for Command, Control, and Communications (C3) students and synthesizes the essence of electronic communications systems and related frequency spectrums into an integrated set of illustrations. The objective is to help the C3 student focus his or her attention on the performed operations and transformations in order to acquire a better understanding for the processes involved. The first major illustration shows how the various components of a communication system are related. These components include analog and digital signals, multiplexing, modulation, and various transmission mediums. Central to any communications system is the limitations imposed by bandwidth and noise. The concept of bandwidth is developed through Fourier analysis. An integrated set of graphics shows the relationship between the time frequency domains and illustrates how the bandwidth increases as the pulse width decreases. Transmitting information often requires higher data rates which, in turn, require high frequencies. Radio wave propagation is frequency dependent and a chart is developed showing the different categories of radio wave propagation as they relate to atmospheric layers and frequency. Finally, a chart relating transmission medium attenuation, noise sources, and various radio wave terminology is given.

**INTRODUCTION TO COMMAND, CONTROL AND COMMUNICATIONS (C3)
THROUGH COMPARATIVE CASE ANALYSIS**

Scott Alan Berg - Lieutenant Commander, United States Navy

B.A., University of Washington, 1977

Master of Science in Systems Technology - March 1990

Advisor: C. R. Jones - Joint C3 Academic Group

This thesis contains material for the course, Introduction to Command, Control and Communications (C3). The first part of the thesis describes selected principles and concepts of C3 related to communication management, interoperability, command structure and standardization. The Crisis Action System is described emphasizing the roles and functions of the Joint Chiefs of Staff and the Office of the Secretary of Defense. a discussion of decision making in command and control examines the principles of unity of command, echelon skipping and span of control. Finally, the Joint Task Force (JTF) apparatus is reviewed from the perspective of interoperability. The second part of the thesis contains four case studies designed to provide an understanding of command and control by developing a competence to diagnose and solve command and control situations. The solutions to the cases require applying the principles and concepts presented in the first part. The four cases are: (1) the Iran hostage rescue attempt; (2) the invasion of Grenada; (3) the raid on Libya; and (4) the rescue of the S.S. Mayaguez.

**DEVELOPMENT OF A THREE DIMENSIONAL TERRAIN DISPLAY
FOR A LIGHT INFANTRY PLATOON COMBAT MODEL**

Thomas G. Dodd - Captain, United States Army

B.S., United States Military Academy, 1981

Master of Science in Systems Technology - June 1990

Advisor: S. H. Parry - Command, Control, and Communications Academic Group

As an augmentation to field training, the author identifies a need for an easily available light infantry platoon combat model that presents a realistic view of the battlefield environment. To meet this need, the author examines the feasibility of developing a realistic three dimensional display of a terrain representation on a personal computer. The target computer provides only limited graphics support with an Enhanced Graphics Adapter and all graphics routines are implemented in the software. Three methods of terrain representation are examined, and the Dynamic Tactical Simulation (DYNTACS) terrain model is chosen for implementation. The DYNTACS representation uses a specialized triangle drawing procedure written in assembly language, the painter's algorithm for hidden surface removal, and Defense Mapping Agency Digital Terrain Elevation Data. The implementation obtains a display rate between 1.2 and 1.5 seconds on a 80386 based 25 MHz computer. The author concludes that with the addition of enhancements that provide the capability to display cultural features, and model the target acquisition process, the program could be developed into a light infantry platoon combat model or a research tool for examining effects of human factors effects on tactical decision making.

**AN ANALYSIS OF FOUR ERROR DETECTION AND CORRECTION SCHEMES FOR
THE PROPOSED FEDERAL STANDARD 1024 (LAND MOBILE RADIO)**

Carol A. Lohrmann - Civilian, GGE-12, Department of Defense

B.S.E.E., Valparaiso University, 1984

Master of Science in Systems Technology - March 1990

Advisor: T. A. Schwendtner - Command, Control and Communications Academic Group

Interoperability of commercial Land Mobile Radios (LMR) and the military's tactical LMR is highly desirable if the U.S. government is to respond effectively in a national emergency or in a joint military operation. This ability to talk securely and immediately across agency and military service boundaries is often overlooked. One way to ensure interoperability is to develop and promote federal communications standards (FS). This thesis surveys one area of the proposed FS 1024 for LMRs; namely, the error detection and correction (EDAC) of the message indicator (MI) bits used for cryptographic synchronization. Several EDAC codes are examined (Hamming, Quadratic Residue, hard decision Golay and soft decision Golay), tested on three FORTRAN programmed channel simulations (INMARSAT, Gaussian and constant burst width), compared and analyzed (based on bit error rates and percent or error-free superframe runs) so that a "best" code can be recommended. Out of the four codes under study, the soft decision Golay code (24, 12) is evaluated to be the best. This finding is based on the code's ability to detect and correct errors as well as the relative ease of implementation of the algorithm.

**THE EFFECT OF THREE VARIABLES ON SYNTHETIC SPEECH INTELLIGIBILITY
IN NOISY ENVIRONMENTS**

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Master of Science in Systems Technology - March 1990

Advisor: G. K. Poock - Department of Operations Research

Military Command and Control (C2) requires easy access to information needed for the commander's situation assessment and direction of troops. Providing this information via synthetic speech is a viable alternative, but additional information is required before speech systems can be implemented for C2 functions. An experiment was conducted to study several factors which may affect the intelligibility of synthetic speech. The factors examined were 1) speech rate, 2) synthetic speech messages presented at lower, the same, and higher frequencies than background noise frequency, 3) voice richness, and 4) interactions between speech rate, voice fundamental frequency, and voice richness. Response latency and recognition accuracy were measured. Results clearly indicate that increasing speech rate leads to an increase in response latency and a decrease in recognition accuracy, at least for the novice user. No effect of voice fundamental frequency or richness was demonstrated.

**UNDERSTANDING THE ORGANIZATIONAL DECISION PROCESS AT THE
THEATER COMMANDER-IN-CHIEF LEVEL OF COMMAND**

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Master of Science in Systems Technology - March 1990

Advisor: C. R. Jones - C3 Academic Group

This thesis focuses on understanding the organizational decision-making process that occurs at the theater Commander-in-Chief (CINC) level of command during times of conflict or war. This thesis is descriptive in nature and concerns the process used to make decisions: it makes no attempt to judge the appropriateness of the process or the quality of the decisions. Using a video record of a seminar-format war game as a data source, the author viewed a theater CINC level decision-making group, coded the decisions, and recorded observations. Subsequent analysis resulted in the generation of hypotheses and conclusions. The author concludes that organizational decision making at the theater CINC level uses a combination of decision processes, with the process depicted by the Carnegie model being the most prevalent. The decision-making group places an emphasis upon goal consensus, and their state of technical knowledge is dependent upon the stability of the external environment.

**MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY
(SPACE SYSTEMS OPERATIONS)**

**SATELLITE SERVICING USING THE ORBITAL
MANEUVERING VEHICLE IN LOW EARTH ORBIT**

**Anthony D. Cutri - Lieutenant Commander, United States Navy
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Master of Science in Systems Technology

Space Systems Operations - June 1990

Advisors: D. C. Boger - Department of Administrative Sciences

H. H. Loomis - Department of Electrical Engineering

This thesis examines the concept of servicing and repair of satellites in low earth orbit (LEO) using the Orbital Maneuvering Vehicle (OMV). The emphasis is primarily focused on current polar orbiting satellites, however, it could be economically applied to any LEO in which sufficient numbers of satellites are located or where individual satellite cost/mission justify servicing. Significant increases in the cost effectiveness and operational flexibility of in-space systems can be realized when the capability to replenish consumable fluids, propellants and Orbital Replacement Units (ORUs) are incorporated into satellite design. ORUs can be placed in orbit using expendable launch vehicles (ELV), specifically selected to satisfy the mission need. Several suitable small payload, low cost boosters are now under development, with the attainment of operational status expected in the early 1990's. The concept calls for modular satellite design and deployment of a new Space Based Support Platform (SBSP) to achieve complete effectiveness. New technology could be applied in the form of upgrades and on-orbit modifications much more efficiently than the abandon and replace policy which currently exists for most satellite systems. The first four chapters provide background on the proposed concept, OMV and ELVs. Chapter five briefly describes several polar orbiting satellite systems providing mass summary breakdowns and current cost information. OMV payload servicing using the Flight Telerobotic Servicer (FTS) is then discussed. A comparison of estimated OMN satellite servicing cost versus satellite replacement for several missions is then tabulated. Conclusions and recommendations are then offered concerning the economic and operational benefits of concept implementation.

**MASTER OF SCIENCE
IN
TELECOMMUNICATIONS
SYSTEMS MANAGEMENT**

**THE FEASIBILITY OF IMPLEMENTING VIDEOTELECONFERENCING SYSTEMS
ABOARD AFLOAT NAVAL UNITS**

**Gregory Joseph Allen - Lieutenant Commander, United States Navy
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Master of Science in Telecommunications Systems Management - March 1990

Advisor: J. E. Suchan - Department of Administrative Science

This study assesses the feasibility of implementing videoteleconferencing systems aboard afloat naval units to support operational reporting, strategy planning, and intelligence sharing requirements. The information richness that videoteleconferencing (VTC) can provide as a substitute for face-to-face meetings would be extremely valuable to senior afloat commanders, particularly when involved in highly ambiguous situations. This study examines the system components and available commercial and military satellite networks like the Defense Commercial Telecommunications Network that can provide the necessary connectivity with fleet commanders ashore. Afloat user requirements are discussed and illustrated by two peacetime scenarios showing the benefit of using VTC systems. An overview of a proposed VTC system installation is provided to illustrate how a system may be installed within the space and weight limitations aboard ship. Finally, the concept of information richness and human factors are provided to illustrate why VTC can be a valuable decision support system during critical situations involving afloat units.

**EXTREMELY HIGH FREQUENCY (EHF) LOW PROBABILITY OF INTERCEPT
(LPI) COMMUNICATION APPLICATIONS**

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Master of Science in Telecommunications Systems Management - March 1990

Advisor: T. A. Schwendtner - Department of Electrical Engineering

A Commander-in-Chief U.S. Pacific Fleet letter to the Chief of Naval Operations, dated September 12, 1989, contains a Command and Control Studies and Analysis Program (C2STAP) proposal for EHF line-of-sight communications. The purpose of this thesis is to address several of the issues raised by the C2STAP proposal by providing: 1) an analysis of the inherent advantages and disadvantages of communications in the EHF spectrum; 2) an analysis of the current and projected future state of EHF technology with respect to potential military applications; 3) a link analysis of an EHF LPI communications link in a specific tactical scenario, and; 4) a recommendation to upgrade the Integrated Refractive Effects Prediction System (IREPS) in order to provide an EHF LPI link assessment capability. Although many other applications are referred to, the primary purpose of this thesis is to assess the feasibility, practicality, and tactical benefit of EHF communication system.

**THE U.S. GOVERNMENT'S ROLE IN FOREIGN TRADE--WHAT IS THE BEST
APPROACH? A CASE STUDY OF THE U.S. SEMICONDUCTOR INDUSTRY**

**Jeffrey D. Carpenter - Lieutenant Commander, United States Navy
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Master of Science in Telecommunications Systems Management - March 1990

Advisor: W. R. Gates - Department of Administrative Science

This thesis examines the current state of the U.S. semiconductor industry in light of its alleged decline relative to foreign producers, specifically Japan, in the hope that an appropriate federal policy might be identified, based on current market conditions. Justification for federal intervention into private sector industry and the appropriate federal intervention methods are included, leading to a discussion of the national security benefits derived from a strong domestic semiconductor industry. Various micro federal government intervention methods are analyzed including a hands off policy, tariffs, anti-dumping measures, strategic stockpiling, DOD production, a Buy American policy, subsidized domestic production, and industry consortia. The goal is to determine how effective they will be in bolstering the U.S. semiconductor industry. However, the problems in the semiconductor industry are seen more as macro problems affecting the economy as a whole. Thus, the recommended intervention policies focus more on macro solutions including changes to the tax structure to encourage savings and discourage debt in order to reduce the cost of capital in the U.S. These solutions will tend to stimulate the economy as a whole, rather than stimulating the semiconductor industry by itself.

**GUIDELINES FOR COMMAND, CONTROL AND COMMUNICATION COMPUTER
NETWORKS FOR THE REPUBLIC OF CHINA NAVY**

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B.S., Republic of China Naval Academy, 1979

Master of Science in Telecommunications Systems Management - March 1990

Advisor: J. H. Lind - Department of Operations Research

This thesis examines design criteria related to development of local and wide area networks for command, control, and communications (C3) systems, especially as such networks could be used by the Navy of the Republic of China, Taiwan. This study stresses the usefulness of modern computer networks, and the importance of considering human factors and artificial intelligence systems during design of these networks. Various network technologies and communication methodologies used for local area networks (LANs) and wide area networks (WANs) are explored. Unified network systems for shore-based and shipbased systems and the integration of these systems are discussed. Information is included to provide Republic of China Navy officers with an awareness of how computer networks can improve C3 functions and make the military more efficient during both peacetime and wartime.

IMPLEMENTATION OF VIDEO TELECONFERENCING FOR THE REPUBLIC OF CHINA NAVY

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B.S., Chinese Naval Academy, 1981

Master of Science in Telecommunications Systems Management - March 1990

Advisor: J. H. Lind - Department of Operations Research

Teleconferencing has been proposed for the Republic of China Navy (ROCN) to reduce costs and increase productivity, while improving communications. The ROCN's need for a modern teleconferencing system is due to the continuing threat from communist China and an ever-increasing number of meetings required for exchange of information and optimal decision making. The basic information concerning teleconferencing technology is discussed. Five categories of teleconferencing systems used throughout the world are described and five kinds of transmission media compared. Human factors system design considerations related to a videoconferencing system in Taiwan are provided. The system design considerations include vision, acoustics, space, temperature, humidity, equipment, and security. A seven-step economic analysis methodology is proposed to evaluate the costs-versus-benefits feasibility of any selected teleconferencing system. This methodology is used to provide evidence that a fiber optics-linked videoconferencing system for the ROCN will be cost effective if it is used for at least 35 meetings each year.

**A PIPELINED IMPLEMENTATION OF NOTCH FILTER USING GENESIL
SILICON COMPILER**

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B.A., Chinese Naval Academy, 1981

**Master of Science in Telecommunications Systems
Management - March 1990**

**Advisor: C. Yang - Department of Electrical and
Computer Engineering**

To implement an IIR notch filter is theoretically feasible but not technically verified or validated. Two methods often used to speed up a computation are multiprocessing and pipelining. In designing a notch filter the pipelining technique is the natural choice to speed up its processing speed. To have a rapid prototype design we may employ the silicon compiler techniques and explore numerous design variations before sending for fabrication. This paper will report the alternative pipelined design of IIR notch filters. We will present the problem, explain the methodologies used in our investigation, analyze the results, and discuss the findings. We first summarize various fixed-point designs for the pipeline building component, the multiplier-adder pair. We then design considerations about the system integration. Various parameters are investigated in our research: pipelined stages, timing, silicon area. Additionally, the experiences and difficulties of using timing verifiers that are built in the silicon compiler will be discussed as well.

ANALYSIS OF END-TO-END PERFORMANCE OF LAN SYSTEMS

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Master of Science in Telecommunications Systems Management - March 1990

Advisor: M. W. Suh - Department of Administrative Science

LAN performance analysis is the main objective of this research. LANs can be configured in various ways. The physical layer combining different medium access control mechanisms and different physical layer specifications divided LLC and MAC. Details on these alternatives are specified in IEEE 802.3 and IEEE 802.5. The queueing network model is one of the analysis tools to investigate the performance characteristics of various LAN configurations. The analysis requires some knowledge of the hardware, software workload and monitoring tools associated with the system. The queueing network models may be single class or multiple class, and the network of queues may be open system or closed system. Simulation is the approach used to evaluate the actual environment. SIMLAN II will be the simulation tool for our work. Our specifications of simulation models involves three classes of transactions, and one or two servers. The input and output of multiple class models are used for three classes of transactions. The network of queues is applied in the closed system. There are 24 simulation results for thesis research. We show the results with respect to LAN utilization, request which are arranged in tables and figures, help compare the performance characteristics of various LAN configurations.

ASSESSMENTS OF ATMOSPHERIC EFFECTS OF VHF AND UHF COMMUNICATIONS

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Master of Science in Telecommunications Systems Management - March 1990

Advisor: K. L. Davidson - Department of Meteorology

Nonstandard gradients of pressure, temperature and humidity in the troposphere create refractive conditions that affect electromagnetic waves by either increasing or decreasing VHF and UHF communication ranges. The Naval Ocean Systems Center (NOSC) has developed the Integrated Refractive Effect Prediction System (IREPS) to assess refractive conditions for a point of interest and provide video display or printouts of how the refractive conditions will affect various EM transmissions. A research cruise was conducted from 1-8 November 1989 in the Eastern Pacific and included 31 rawinsonde launches. The data from the rawinsondes was entered into IREPS PC Version 1.0 to assess the refractive conditions. The IREPS-generated refractive assessments were then compared to the GTE Sylvania Report and the Pacific Missile Test Center's Interim Procedure for Forecasting Refractivity Conditions (IPFRC). The results indicated that the GTE Sylvania climatology was not an accurate tool for assessing refractive condition at sea mainly because the GTE data set consisted of shore-based rawinsonde data. The IPFRC, based solely on synoptic weather parameters, obtained a 60% success rate in predicting the likelihood of the presence of refractive conditions.

**IDEAL SYSTEM CAPACITY AND DEMAND CONTROL FOR THE NAVY
TELECOMMUNICATIONS SYSTEM: AN ECONOMIC ANALYSIS**

Jeffrey J. DeLeeuw - Lieutenant, United States Navy

B.A., University of Illinois, Urbana, 1979

Master of Science in Telecommunications Systems Management - March 1990

Advisor: W. R. Gates - Department of Administrative Science

The Naval Telecommunications System (NTS) capacity to handle message traffic is frequently exceeded by high levels of user demand often resulting in a failure to meet message speed of delivery standards. In order to resolve this problem, managers of the NTS must decide to either expand system capacity, control demand, or apply some combination of these two alternatives. The purpose of this thesis is to analyze this situation and make recommendations based upon the application of economic theory. The principles leading to the definition and understanding of optimal system capacity and user demand are laid out as they apply to the NTS. Having established a theoretical rationale for defining the ideal system capacity, a number of significant practical barriers to the implementation of this approach are explored. These barriers can be characterized as deriving from the tremendous difficulties encountered in the attempt to quantify cost and demand parameters necessary for determining the actual level of optimal system capacity. Although a straightforward method of applying the relevant economic principles cannot be found, the theories discussed are of practical use, nevertheless, in that they predict a situation wherein the application of demand reduction techniques would be appropriate. This situation arises out of the fact that current NTS practices impose negligible costs upon users of the system. This in turn can be predicted to result in high levels of user demand with many of the messages serviced being of relatively low value. The results of a judgmental survey carried out on both Naval telecommunications and fleet operations personnel provide a preliminary confirmation of these conclusions. The recommendation is then made to implement some type of demand management scheme. A review of available demand management tools is made leading to the final recommendation that some form of demand based pricing strategy, incorporating elements of both priority and peak load pricing methods, should be adopted. One major objection to the efficacy of pricing techniques is addressed by way of reference to the Naval fuel allocation system and its effectiveness as a means of managing demand for fuel. Lastly, areas requiring significant further study pertaining to demand management and pricing methods are outlined.

**TELECOMMUNICATION SYSTEM FOR BACHELOR OFFICER QUARTERS:
COST-EFFECTIVENESS AND LEASE/PURCHASE ANALYSIS**

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B.S., Purdue University, 1984

Master of Science in Telecommunications Systems Management - June 1990

Advisor: W. R. Gates - Department of Administrative Science

The purpose of this thesis is to perform a cost-effectiveness analysis on proposals, submitted by vendors, for a telecommunication system. This thesis will be used as a guide in the decision-making process of choosing the most cost-effective system for the Bachelor Officer Quarters of the Naval Postgraduate School. In addition to cost effectiveness, this study includes a discussion of the analysis criteria, a review of Statement of Work and an evaluation of the lease/purchase decision.

**THE FUNCTIONAL INTEGRATION OF COMMUNICATIONS AND ADP SERIAL
TECHNOLOGY AT NAVCOMMSTA STOCKTON AND NARDAC SAN FRANCISCO**

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and

David R. Vasquez - Lieutenant, United States Navy

B.A., University of New Mexico, 1982

Master of Science in Telecommunications Systems Management - March 1990

Advisors: C. R. Jones - C3 Academic Group & N. C. Roberts -

Department of Administrative Science

The thesis examines the functional integration of serial technologies at NAVCOMMSTA Stockton and NARDAC San Francisco, two echelon II Naval Commands affected by the 1989 decision to merge Navy Communications and Automated Data Processing disciplines. Decomposing the transformation process, input to output, is accomplished by viewing the organizations in terms of structural and contextual dimensions and serial technologies. Functional tasks for each organization are derived from interviews, observations, document reviews, telephone calls, and literature. Representative similarities and differences are provided along with recommendations concerning functional integration. Comparison of functional similarities provides a means for approaching a partial functional integration of serial technologies. The organizations are not aligned nor mapped for comparison of resource and technological interdependencies which would achieve greater efficiency through economies of scale, economies of scope, or both. A strategic design which capitalizes on the strengths of each organization is recommended.

**SURVEILLANCE TECHNIQUES FOR THE VESSEL TRAFFIC
SERVICE SYSTEMS OF THE U.S. COAST GUARD**

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Master of Science in Telecommunication System Management - June 1990

Advisor: M. W. Suh - Department of Administrative Science

The U.S. Coast Guard operates several Vessel Traffic Services (VTS) in major U.S. shipping ports. These systems were designed and implemented twenty years ago. They were designed for a single mission, port safety. The surveillance and display systems are well beyond the planned service life and need to be replaced. This thesis investigates and summarizes up-to-date methods of providing surveillance services to a VTS. The author includes a history of VTS, an analysis of the assigned missions, and a review of the C² factors involved. A functional model of VTS is developed and used to evaluate the best mix of technologies for VTS systems. The author concludes that a mixture of shore-based radar surveillance and satellites based surveillance can provide the detection and identification information necessary to operate a multi-mission VTS. In order to take advantage of inexpensive narrow band data links, such as voice grade telephone circuits, radar information must be processed through a radar scan convertor. Use of this technology also improves automated target detection, tracking, and display capabilities of the existing radar and display systems. A second generation VTS should have a modular design, centered around a standardized Vessel Traffic (VTC) C² system. This will reduce the cost of operating a VTS by reducing the manpower needs of a VTC, improving the performance of the VTS system during multi-mission tasking, allowing the use of different sensor types and creating a way of integrating VTS information into the main stream of Coast Guard Operations.

TELEPHONE PRIMER

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Master of Science in Telecommunications Systems Management - September 1990

Advisor: A. W. Tulloch - Department of Administrative Science

The telephone is the most common and widely used electronic communication device in use today. Because of this, the military is heavily reliant on the telephone system and considers it the primary voice communications medium. Furthermore, recent technological advances will dramatically change the telephone as we know it today. This thesis will take a comprehensive look at the telephone in today's complex telecommunications environment. It will describe the technical aspects of individual components as well as how the system works as a whole. The divestiture of AT&T will be analyzed, especially the effects it has had on the military. After describing the historical and technical aspects of the telephone system, the thesis will focus its attention on military telephone programs and upgrades being planned to increase telephone capabilities and survivability.

LEASE VERSUS BUY DECISION METHODOLOGY FOR THE KOREAN ARMY: A PROPOSAL

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B.S., Korea Military Academy, 1985

Master of Science in Telecommunications Systems Management - March 1990

Advisor: J. G. San Miguel - Department of Administrative Science

The Korean Army currently does not have a prescribed methodology to determine the lease versus buy financing of items procured from private industry. This study provides a general analysis of the Korean Army's lease versus buy decision methodology, especially computer hardware systems. It gives general background information on lease versus buy decision in both the public and private sectors. It also examines a specific example of lease versus buy decision analysis in public sector. However, the analysis shows that cost considerations do not always receive top priority. Military policies, technical sophistications, maintenance, and discount rate are among the other factors considered in lease versus buy analysis.

A BASIS FOR A COMMAND, CONTROL AND COMMUNICATIONS (C3) SYSTEM ARCHITECTURE FOR THE ARGENTINE ARMY

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Master of Science in Telecommunications Systems Management - March 1990

Advisor: D. C. Boger - Department of Administrative Science

This thesis represents an initial effort to define the characteristics of a command, control, and communications (C3) architecture. It provides a basic understanding of the command and control process, command, control and communications architecture, and command, control and communications system analyzed from the point of view of an information system. The ultimate goal of this thesis is to introduce the basic concepts of C2 process, C3 architecture and C3 system to the Argentine Army.

LOCAL AREA NETWORKING HANDBOOK

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Master of Science in Telecommunications Systems Management - June 1990

Advisor: D. C. Boger - Department of Administrative Science

This thesis provides Navy shore based commands with sufficient information on local area networking to 1) decide if they need a LAN; 2) determine what their networking requirements are, and; 3) select a LAN that satisfies their requirements. LAN topologies, transmission media, and medium access methods are described. In addition, the OSI reference for computer networking and the IEEE 802 LAN standards are explained in detail. A method for conducting a LAN requirement assessment is discussed, followed by a strategy for selecting a local area network.

PRIVATE TELECOMMUNICATIONS SYSTEMS: A SYSTEMS APPROACH

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Master of Science in Telecommunications Systems Management - September 1990

Advisor: D. R. Whipple - Department of Administrative Science

This study examines the importance of private telecommunication system for voice and data communication. It demonstrates an orderly process through which a medium-sized organization can transform a complex telecommunication environment to a progressive and self-reliant telecommunication utility. The process of planning private telecommunications systems is discussed in detail with an emphasis placed on the comparative evaluation of computerized branch exchange (CPBX) and local area networks (LAN). This study shows that computerized private branch exchange is preferable to local area network in a medium-sized organization in general.

THE DEVELOPMENT OF A DATABASE MANAGEMENT SYSTEM FOR LIBRARY LOAN MANAGEMENT

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B.S., Kyung-Pook National University, 1982

Master of Science in Telecommunications Systems Management - March 1990

Advisor: M. W. Suh - Department of Administrative Science

This thesis deals with the procedures for and the issues in the analysis, design, and implementation of Library Loan Management System (LLMS). LLMS is a low-volume real-time transaction processing system intended for small or medium size libraries. It is designed to provide such library functions as library cataloging, patron registration, circulation, and reference services based on a relational database management system. We implemented prototype LLMS to run on IBM PC/AT or XT compatible microcomputer using dBASE IV. The developed prototype system has been documented in this thesis. We also discuss some issues in implementing LLMS in a networked environment.

A COMPREHENSIVE GUIDE TO C3 SYSTEM DEVELOPMENT

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Master of Science in Telecommunications Systems Management - March 1990

Co-Advisors: C. R. Jones - Command, Control and Communications

Academic Group & D. C. Boger - Department of Administrative Science

This thesis provides guidelines to develop a C3 system, including both organizational and physical systems. It contains the concept, architecture, design and engineering approaches, the integrated C3 framework, test and evaluation methodologies, system acquisition procedures, system development constraints and environment, and C3 research trends. This thesis is mainly descriptive and is comprehensive to help beginners in the C3 research area. It will give a fundamental understanding about the roles of all individual researchers, that is, the roles of people in computer science, operations research, military science, physiology, social science, organizational management, and so on. The focus of this thesis is on the decision-oriented design and engineering activities based on a consistent approach such as time-uncertainty distribution over the command and control process. For the real implementation of the C3 application system, the "battlefield equation" is introduced as a primary model modifying prior studies.

COMMUNICATION PLANNING FOR AMPHIBIOUS OPERATIONS

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Master of Science in Telecommunications Systems Management - March 1990

Advisor: D. C. Boger - Department of Administrative Science

The purpose of this thesis is to provide the reader with a basic introduction to amphibious operations and to present the complex communication planning efforts required to ensure a successful operation. These planning efforts culminate in a communication plan for the amphibious operation designed to meet the needs of the amphibious commander. This thesis presents the full scope of communication planning required by the amphibious and landing force commanders from the preliminary planning phase of the operation until its termination. After a basic overview of amphibious operations, we describe the command and control agencies created to assist the amphibious commanders during the conduct of the operation and the command and control systems designed to support them. The study then discusses the various communication means available to the amphibious task force, the requirements of communication planning, and the formulation of the communication plan and its supporting documents. Next we detail the Electronic Warfare and Operations Security measures required to ensure effective communications throughout the operation and the required communications for each phase of the operation. We conclude with several recommendations for future improvements in communication interoperability, integrity, and supportability. This thesis is presented in a manner so that an individual, with no prior experience in amphibious communication planning, will have the basic tools necessary to prepare a communication plan designed to satisfy the requirements of an amphibious operation.

**A PROPOSED MESSAGE SYSTEM ARCHITECTURE FOR A MARINE CORPS BASE
IMPLEMENTATION OF THE DEFENSE MESSAGE SYSTEM (DMS)**

**John F. Weigand - Captain, United States Marine Corps
B.S., University of Nebraska, 1980**

Master of Science in Telecommunications Systems Management - March 1990

Advisor: N. F. Schneidewind - Department of Administrative Science

The current Automatic Digital Network (AUTODIN) communications system provides excellent message communications service within the Defense Communications System. However, AUTODIN speed of service objectives end at the Telecommunications Center (TCC). This gap between AUTODIN and end-user organizations causes delays and frustration to users who expect minimal delay in writer-to-reader message service. The Defense Message System (DMS) promises to deliver true writer-to-reader message service by extending automation from the TCC to the organizational level. DMS also promises to standardize message communication services for DOD Services/Agencies. This paper proposes a phased DMS implementation for a Marine Corps Base (MCB). Additionally, the protocol conversion processes illustrate some significant issues present during the transition to DMS. The intent of this paper is to suggest a network topology to implement DMS with additional dividends of using this topology with minimal rehabilitation in implementing succeeding DMS phases.

**MASTER OF ARTS
IN
NATIONAL
SECURITY
AFFAIRS**

ALTERNATIVE FUTURES IN U.S. NUCLEAR STRATEGY

Jerry Randall Anderson - Lieutenant, United States Navy

B.S., United States Naval Academy, 1983

Master of Arts in National Security Affairs - December 1989

Advisor: E. J. Laurance - Department of National Security Affairs

This thesis examines the future of United States nuclear strategy from the alternative futures/scenarios methodological approach. It begins by tracing the evolution of U.S. declaratory strategic policy from the end of World War II to the present. Specifically, it focuses on those particular environmental threats, constraints, and resources that were fundamental to the development of a nuclear strategy for each time period. The same kind of analysis is used to examine four alternative future security environments. Specific nuclear strategies are then developed for each alternative world scenario. The U.S. Navy's Maritime Strategy, especially the nuclear component, is presented as an example of the strategy development process. Finally, the process of strategic planning in the military and long-range planning in general are discussed.

THE FULCRUM OF NECESSITY: STRATEGIC PLANNING BEFORE PEARL HARBOR

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B.A., Gustavus Adolphus College, 1977

Master of Science and Arts in National Security Affairs - June 1990

Advisor: F. M. Teti - Department of National Security Affairs

This thesis is a historical analysis of the evolution of strategic planning in the United States during the years 1919-1941. It examines the interwar genesis of U.S. strategic culture, and focuses on three aspects: structure, process, and products. Army, Navy, and joint planning agencies, as well as their interrelationships, are analyzed. Within the military, the planning process was limited throughout the interwar years by the lack of national policy guidance. Moreover, the joint planning process was hindered by a lack of executive authority and inattention to the production and incorporation of strategic intelligence information. The products of interwar planning efforts were increasingly sophisticated strategic plans and, more importantly, a corps of strategists who were subsequently able to craft the winning strategy for World War II. The study concludes that despite its *ad hoc* origins, the American planning structure produced successful strategic thinkers and concepts, and the interwar years provided the seminal impetus for the development of joint planning.

PRESIDENT ASSAD'S FOREIGN POLICY

Antun Attallah

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Master of Science in National Security Affairs - June 1990

Advisor: R. H. Magnus - Department of National Security Affairs

This "thesis" is a study of Assad's foreign policy and the factors that helped him consolidate his power and transform his country from a proxy state to a regional power. Syria's relations with its neighbors and the two "superpowers" are discussed in detail. Syria's strategic significance is accentuated here; it is a remarkable specimen in the Middle East political aquarium. Syria had a glorious history. The Syrians are working very hard to restore that glory—the glory of Great Syria. Syria's modern history has been a saga of coups and counter coups. After leading a bloodless coup in 1970, Assad took over. Under the leadership of President Assad, Syria has been transformed from a weak, shaky, and vulnerable country into an apparently strong and stable state, a regional power in the Middle East. What the Syrians and their president want is precisely what nationalists have always wanted in every part of the world: an integrated (Syrian) society, which is industrialized, modernized, centralized, socialized, and populated by proud and spirited masses; which enjoys the independence in the anarchic, chronically unstable pervasively violent and breathtakingly convulsive Middle East.

**BRITISH AND FRENCH STRATEGIC NUCLEAR FORCE MODERNIZATION:
PROGRAMS, STRATEGIES, AND IMPLICATIONS**

Darryl Wayne Bates - Lieutenant, United States Navy

B.A., University of Virginia, 1983

Master of Arts in National Security Affairs - December 1989

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Britain and France are currently modernizing and expanding their nuclear arsenals. This thesis examines the current British and French strategic nuclear force modernization programs and weapon systems. It specifies the important differences between the two nations with regard to strategic rationales for nuclear forces and nuclear targeting. It includes an analysis of several additional factors affecting their respective modernization programs, including alternative options considered, domestic politics, technology, national economies, defense spending, and American co-operation. After examining these modernizations within the context of the past and present development of British and French deterrence and strategic nuclear policies, the thesis suggests implications for British and French nuclear programs and strategy for the next decade and into the twenty-first century.

**IN THE MIND'S EYE: CULTURAL INFLUENCE
IN DEFENSE ANALYSIS AND STRATEGIC PLANNING**

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This study examines the fundamental influence that culture has on the process and products of defense analysis and strategic planning. It demonstrates that culture, as the primary source of the policy-maker's epistemology, is an essential determinant of the outputs of the strategic planning process. Culture has this effect because strategic planning is nothing more than a collection of considered judgments, but judgments made through the "perceptual lens" created by one's own culture. The study looks at the components of culture: how and why it forms, is maintained, and changes in support of a specific group's internal integration and external adaptation functions. Through this effort, culture is exposed as a primary cause of individual and collective behavior. As such, it is presented a principal source of data for understanding and explaining national behavior in the international environment. Concurrently, the study shows that strategic planning, as a fundamentally value-laden process, is highly susceptible to the negative effects of a perspective biased by the planner's own acculturation. Therefore, the subjects of ethnocentrism and cultural relativism are examined. This study also investigates the concepts of "strategic culture" and "national style" in strategy. It shows that strategic culture may be analyzed as the culture of a nation's "security community." National style, in turn, is presented as an artifact of the strategic culture. Finally, a "strategic behavior model" is presented and briefly tested to demonstrate the methodological linkage between strategic-cultural assumptions and specific security behavior.

**NAVAL DIPLOMACY BENEATH THE WAVES: A STUDY OF THE
COERCIVE USE OF SUBMARINES SHORT OF WAR**

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Master of Arts in National Security Affairs - December 1989

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This thesis addresses one dimension of "naval diplomacy," namely submarine naval diplomacy. It examines the suitability and/or desirability of employing submarine forces for naval-diplomatic purposes. It reviews the historical record of "underwater gunboat diplomacy," the particular aims that its practitioners have sought to achieve, and it examines the opportunities and constraints for the assignment of submarines for future naval diplomacy purposes.

**STRATEGIC RESOURCES OF IRAQ, TURKEY AND IRAN AND THE
DEVELOPMENT OF KURDISH NATIONALISM: THE DOMESTIC,
REGIONAL AND INTERNATIONAL CONTEXT**

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This research examines the strategic resources of Iraq, Turkey and Iran with particular emphasis on those assets found in the Kurdish regions of these nations. Strategic resources, in the context of this discussion, are defined as oil and nonfuel mineral assets and agricultural potential, to include degree of soil productivity and availability of water supplies. To the extent applicable, industrial development is discussed as well. Kurdish history, language and culture and the Kurdish nationalist movement in the three nations are also examined. Superpower and regional interests in the Kurdish nationalist movement and the governments of the nations involved are also addressed.

**POLAND AND THE UNITED STATES: ACHIEVING AMERICAN NATIONAL
INTERESTS IN EASTERN EUROPE IN THE 1990'S**

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The analysis in this thesis supports a recommendation to provide Poland \$750 million a year in assistance for ten years. This program will allow the Polish government the time required to install a democratic system with a free-market economy. The assistance can be provided by either increasing foreign aid and private business incentives to invest in Poland, or by focusing the majority of the already authorized foreign aid for Eastern Europe into Poland, versus spreading it out over the entire region. The suggested policy could achieve the following goals: one, reducing Soviet influence in Europe; two, encouraging a Polish government supporting of American foreign policy; three, preventing the growth of popular disenchantment over the immediate results of democratic reforms. Poland as a strong and stable nation will act as a bastion against any future Soviet attempt to regain control of Europe. A weak Poland could ultimately result in a general European conflict and American troops being recommitted to the continent.

**COUNTERINSURGENCY STRATEGY FOR EFFECTIVE CONFLICT
TERMINATION: US STRATEGY IN EL SALVADOR**

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This study examines problems which the United States faces in its support of efforts by other governments to defeat revolutionary insurgents. The U.S. has in the past been drawn into supporting conflicts for a protected period, at increasing costs, without receiving apparent benefit nor approaching a favorable end to the conflict. This thesis addresses reasons why the U.S. encounters problems in its support of counterinsurgency efforts and has difficulty in effectively terminating this type of low-intensity conflict. The study assumes that to achieve its long-term goals the best outcome for the U.S. in most cases of insurgency is to obtain a negotiated settlement. After producing a list of factors necessary to produce a negotiated settlement, the study examines various counterinsurgency strategies used in El Salvador to see how they are affected. The study concludes that while the U.S. has improved in its counter-insurgency strategies there are problems within the U.S. Military and political organization which inhibit the U.S. ability to achieve effective termination of the insurgency, including the lack of consistent pressure on the host government and military to reform and to compromise on settlement conditions, and the persistence of the desire within the U.S. administration to achieve a military victory.

TRIAD OR DYAD FOR THE 1990s: A BALANCE OF REALITY

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As the United States enters the decade of the 1990s, it is essential to review the guidance and policies for our force structures. At the focal point of discussion on future force structures for the United States is the strategic nuclear forces. The strategic nuclear force structure for the United States has been predicated on the concept of a Triad, which consists of three legs, referred to as land-based, sea-based, and manned bombers. Each of the legs consists of separate components. Understanding the tradition of the United States strategic deterrent being predicated on the Triad concept, it is felt that with the changing international environment and the declaratory statements for continuing to decrease the Defense Budget, a new and realistic review of the factors for determining a strategic nuclear force should be researched. Therefore, the intention of this thesis is to review and analyze the five factors which may contribute to the formulation of a realistic policy for the 1990s with regard to United States strategic nuclear forces. The final results of the research have indicated sufficient evidence that a policy review of the strategic nuclear Triad should be conducted to meet the challenges and realities of the 1990s and the 21st Century.

CHALLENGE AND RESPONSE: NEW THREAT, NEW CONSTRAINTS, NEW NAVY

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The apparent reduction in the magnitude of the Soviet threat must not obscure the fact that challenges to the national interests of the United States still remain. This thesis proposes that challenges to U.S. national interests have changed to such a degree that American strategic planners must adopt a new planning paradigm to replace the traditional one based on containment of the Soviet Union. The thesis focuses on naval force and organizational planning over the next ten to fifteen years, a timeframe during which the international environment should undergo a transition to a multipolar balance of power system. The thesis concludes that the Navy of the future can be smaller, but must retain its technological superiority in all areas of warfare. A vigorous research and development (R&D) effort remains essential, and production of new systems and platforms must continue, albeit in smaller numbers and at higher unit costs. Projection of power ashore will be the principal mission of conventional naval forces. Organizationally, the Navy must expand its intelligence gathering efforts, and must formalize career progressions for Strategic Planner, International Negotiators and Legislative subspecialists. The thesis includes a discussion of significant domestic constraints that promise to jeopardize the attainment of the desired force structure.

THE SOVIET NUCLEAR WEAPON FREE ZONE PROPOSAL

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An examination of the Nordic Nuclear Weapon Free Zone (NWFZ) proposal and its ramifications for NATO, the United States and the West. A Nordic NWFZ would be detrimental to US, NATO, and Nordic national security interests. Agreement on a NWFZ is not likely by the United States, Soviet Union, Denmark, Norway, Finland, Iceland, Greenland, and Sweden. The debate breaks down to a "tug of war" between two superpowers. It is not the nuclear weaponry, but the politics surrounding the weaponry that is the heart of the nuclear free zone debate. By leaving out politics, one is ignoring the true sources of conflict and instability. Changing world politics demand that the West develop a unified strategy toward the Soviet Union and its initiatives. Through NATO it must preserve its vital economic, political and military objectives in the Northern Flank. Flexible naval forces and strong political and economic ties to the governments of the nations bordering the Baltic are essential. Strong NATO naval forces operating in the waters of the Baltic must be seen as guarantors of the West's strategic aims interests. A Nordic NWFZ would present this.

**RETHINKING THE MARITIME STRATEGY FOR THE 1990'S IN TERMS
OF EUROPEAN SECURITY**

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This work reexamines the warfighting component of the Maritime Strategy in light of recent political changes in the communist world as well as recent arms control advances. The following conclusions are reached: first, a Conventional Forces Europe (CFE) agreement and the political changes in Eastern Europe will make mobilization and reinforcement key factors in any future European conflict. Secondly, under the conditions of a START agreement, it will no longer be necessary for the Soviet Union to form protected bastions to guard its SSBNs; seeking out and attacking Soviet SSBN's could be more risky and destabilizing. Thirdly, the START and CFE agreements, combined with improving Soviet submarine technology, will make the likelihood of a Soviet SLOC interdiction campaign much greater in the event of future conflict; the U.S. should adopt a layered defense strategy in response to these developments. Fourth and finally, because of the political difficulties associated with ground-based intermediate-range nuclear forces, the U.S. Navy must be assuming a larger role in providing theater nuclear deterrence in Europe.

**COMBATTING TERRORISM THROUGH STUDY OF THE GENETIC
PSYCHOLOGY OF TERRORIST LEADERS--THE EARLY DEVELOPMENT
OF THE TERRORIST MIND**

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The purpose of this thesis is to demonstrate the necessity for law enforcement, intelligence, and other organizations responsible for collecting information on "proponents of terror," to include in target dossiers, data regarding genetic inheritance and childhood environmental influences. The author argues that without this type of information, agencies are hindered in really knowing the "proponent of terror," and thus limited in the possibilities for neutralizing the subject. The study analyzes genetic inheritance and childhood environment and presents case studies on Adolf Hitler, Benito Mussolini, and Ilich Ramirez Sanchez ("Carlos"). The study concludes that genetic and childhood environmental data should be included in target dossiers of terrorists. Collection categories in genetic inheritance and environment are recommended and include, for example, material on terrorists' biological grandparents, parents, and as appropriate, on their brothers and sisters, and children.

**INTEGRATION OF THE EUROPEAN ARMS INDUSTRY: AN ANALYSIS OF KEY
VARIABLES AND PROCESSES IN FRANCE, BRITAIN, AND THE FEDERAL
REPUBLIC OF GERMANY**

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Advisor: E. J. Laurance - Department of National Security Affairs**

This thesis analyzes key variables and processes in France, the United Kingdom, and the Federal Republic of Germany in an attempt to determine the factors unique to each nation that tend to inhibit or promote movement toward integration of the European arms industries. For the purposes of this study it is assumed that defense production costs will be constantly increasing, while a variety of other global factors continue to produce a smaller arms market and increased competition among suppliers. With these factors known, the political, military, and economic roles of national arms industries are isolated as potential indicators of future integration in Europe and the significance of a joint venture involving any of these nations may be judged with greater confidence.

**THE UNITED STATES, THE SOUTH ATLANTIC, AND
ANTARCTICA INTERESTS AND CHALLENGES**
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The United States currently has interests in the South Atlantic and Antarctica which have traditionally taken a back seat to U.S. interests in other regions. In the closing years of the twentieth century, those interests likely will receive more attention as the United States and the global community shifts its attention from the traditional focus on East-West issues and their conflict potential to more nationalist interests. This thesis examines U.S. interests in the South Atlantic and Antarctica and evaluates the potential challenges to those interests. The thesis concludes that, while its interests in the South Atlantic remain, the United States will find it increasingly more difficult to extend its influence as the countries of the region exert more national will and as extra-hemispheric actors gain a more significant foothold.

**THE EFFICACY OF U.S. AND U.S.S.R. ARMS TRANSFERS FOR THE
MAINTENANCE OF REGIME STABILITY IN THE THIRD WORLD**
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The relationship between U.S. and U.S.S.R. arms transfers to Third World nations and its effects on the maintenance of regime stability was examined. This study uses the focused comparison approach to examine three U.S. cases (Vietnam 1960-1975, the Philippines 1950-1989, and El Salvador 1960-1989) and three U.S.S.R. cases (Afghanistan 1950-1989, Vietnam 1976-1989, and Nicaragua 1979-1989). The U.S. and Soviet cases were chosen due to the intuitive similarities found in the supplier nation's involvement with the recipient Third World nation. The trend in the amount of arms transfers was determined in each of the cases and compared to the resulting levels of internal threat, external threat, and the overall level of regime stability.

**DISINTEGRATION IN PERU - CONSOLIDATION IN CHILE:
THE CASE FOR MILITANT CAPITALISM IN LATIN AMERICA**
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Over the past two decades, Peru and Chile have been experienced both military regimes and civilian governments. Peru's experience has been dominated by the political left; Chile's by the right. In contrast to Peru's populist politics and interventionist economics, Chile, in 1973, experienced a militant capitalist revolution. Almost twenty years later, Peru is a nation torn by political violence of both the left and right; on the brink of economic and cultural ruin. Conversely, Chile has passed beyond military government and begun democratic consolidation. With the healthiest economy in contemporary Latin America, Chile is poised to move beyond under-development to modernity. Chile's success is the direct result of the fundamental restructuring and redirection of the nation's politics-economics paradigm undertaken by General Pinochet and the military but accepted, and today embraced, by the Chilean people. Development of a free market economic model that transcends partisan politics is the key to Chile's success and future. It is likewise a lesson which Latin American states should incorporate in both national policies and international relations.

FROM FORWARD DEPLOYMENT TO FORWARD PRESENCE: A NEW STRATEGY FOR THE PACIFIC

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Master of Arts in National Security Affairs - March 1990

Advisor: C. A. Buss - Department of National Security Affairs

This thesis analyzes the changing strategic environment in East Asia and the Pacific. Despite sweeping foreign policy initiatives, the Soviets maintain a significant military capability. Even as the likelihood of the Soviet threat diminishes, low-intensity type conflicts threaten U.S. regional interests. Additionally, changing regional perceptions are undermining traditional U.S. security arrangements. Rising Asian nationalism questions the need for forward deployment of U.S. forces within regional states. A policy of forward presence via maritime assets is the solution. U.S. naval assets would allow for a reasonable power projection capability in time of crisis, yet would meet fiscal constraints during peacetime through a scaling down of deployed assets. Other U.S. forces will maintain their ability to meet regional responsibilities through training exercises with regional forces and a build-up of the U.S. sealift capability. Now is the time to encourage regional states to assume greater responsibilities for their own defense. A regional maritime organization must be developed to maintain open trade routes. With a focused mandate, such an organization would not threaten individual national sovereignties and would promote regional cooperation and stability. An expansion of the U.S. Navy's peacetime mission will certainly serve the national interest. Increased port visits to economically less developed regions should be coordinated to support on-going or planned U.S. assistance programs.

UNITED STATES-JAPANESE NATIONAL INTERESTS IN ASIA: SECURITY IN THE 1990'S

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Perceptions of the bilateral security relationship between the United States and Japan are beginning to depart the post-war norm. Japan's economic competition is beginning to be seen by some in the United States as a greater threat to U.S. national security than the traditional threat of Soviet expansionism. A difference in fundamental values between the United States and Japan may exacerbate these diverging views during a period of dramatic East-West change. This thesis proposes that the U.S. and Japan re-examine their bilateral security relationship and replace it with a formal, rational division of burden and decision sharing by allocating primary areas of security responsibility in Asia within the alliance. It proposes that Japanese naval forces assume primary responsibility of stability and peace in Northeast Asia while the United States continues primary responsibility of stability and peace in the vital sea lanes of communication in the Indian Ocean and South China Seas. The flexibility of this strategy would permit coping with the uncertainty of United States-U.S.S.R. relations until the success or failure of Soviet reforms can be ascertained. Also, a revised security arrangement between the United States and Japan would diminish the prospects of an independent Japanese military posture in Asia.

U.S.-PORTUGUESE RELATIONS AND FOREIGN BASE RIGHTS IN PORTUGAL

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Master of Arts in National Security Affairs - June 1990

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This thesis examines the United States' relationship with Portugal and its significance for past, present, and future U.S. use of basing facilities in the Azores. The U.S.-Portuguese relationship is grounded largely in U.S. geostrategic imperatives and Portuguese military needs. Several factors, including changes in the USSR and Eastern Europe and Portugal's economic revitalization and increasing ties with Europe, justify a reappraisal of certain aspects of Portugal's military relationship with the United States. It would be advantageous on many grounds to cultivate improved social, political, and economic ties between the United States and Portugal and thereby complement the security relationship, including U.S. access to Azorean bases. This thesis also analyzes Portuguese relations with France and the Federal Republic of Germany - the two other nations granted base rights in Portugal. This allows an extensive comparative analysis of French, West German, and American basing relations with Portugal. Finally, the thesis examines the Portuguese military's status in society and politics.

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