MISSION

Increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.

The research program at NPS exists to support the primary mission of graduate education. Research at NPS:

- maintains upper division course content and programs at cutting edge;
- challenges students with creative problem solving experiences on DoD relevant issues;
- advances DoN/DoD technology;
- solves warfare problems; and
- attracts and retains quality faculty.

ACADEMIC PROGRAMS

To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization tying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has aligned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer’s career.

3 INSTITUTES
-The Cebrowski Institute for Information Innovation and Superiority
-Modeling, Virtual Environments, and Simulation (MOVES)
-The Wayne E. Meyer Institute of Systems Engineering

4 SCHOOLS
-Graduate School of Engineering and Applied Science
-Graduate School of Operational and Information Sciences
-Graduate School of Business and Public Policy
-School of International Graduate Studies

Core Characteristics
-Integrated
-Systems-Oriented
-Partnered for strength
-Flexible

Institutes ensure that education provided by the schools is applied to military challenges.
INTRODUCTION

Programs of Graduate Studies at NPS are grouped as follows:

**Graduate School of Operational and Information Sciences**
- Computer Science
- Computers and Intelligence (C4I) Systems
- Electronic Warfare Systems International
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Operations Analysis
- Operations Logistics
- Software Engineering
- Special Operations/Low Intensity Conflict

**Graduate School of Engineering and Applied Sciences**
- Combat Systems Science and Technology
- Electrical Engineering
- Electronic Systems Engineering
- Engineering Acoustics
- Meteorology
- Meteorology and Oceanography
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors/Mechanical Engineering

**Graduate School of Business and Public Policy**
- Acquisition and Contract Management
- Contract Management
- Defense Systems Analysis
- Defense Systems Management (International)
- Financial Management
- Information Systems Management
- Leadership Education and Development
- Manpower Systems Analysis
- Material Logistics Support Management
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Transportation Management

**School of International Graduate Studies**
- Civil-Military Relations
- Defense Decision Making and Planning
- Homeland Security Leadership Development
- National Security and Intelligence
- Europe/Russia/Central Asia
- Far East/South-East Asia/Pacific
- Middle East/Africa/South Asia
- Western Hemisphere

**Interdisciplinary Curricula**
- Modeling, Virtual Environments, and Simulation
- Product Development
- Space Systems Engineering
- Space Systems Operations
- Space Systems Operations International
- Systems Engineering and Analysis
- Systems Engineering Management
- Undersea Warfare

**Students**
The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government and military officers and government civilian employees of other countries. Resident degree/subspecialty student population for March 2004 is shown in Figure 1 on the following page.
Academic Degrees
Although the curricula are tailored to address defense requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a master’s degree; however, additional study can lead to either an engineer’s degree or the doctor’s degree. Below is a listing of the degrees offered at NPS:

Master of Arts Degrees
National Security Affairs
Security Studies

Master of Business Administration
Executive MBA
Master of Business Administration

Master of Science Degrees
Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Combat Systems Technology
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Systems and Operations
Information Technology Management
Leadership and Human Resource Development
Management
Materials Science and Engineering
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Product Development
Program Management

DoD Civilian
Army 8%

Air Force 10%

Marine Corps 11%

International 24%

Figure 1: Resident Degrees/Subspecialty Student Population for March 2004
(Total Enrollment: 1,643)

*U.S. Coast Guard, U.S. Army National Guard, U.S. Army Reserve

Academic Degrees

Engineer Degrees

Doctor of Philosophy

Doctor of Engineering
There were 142 degrees conferred in March 2004. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.

*Electrical Engineer (1); M.S. Contract Management (1); M.S. Engineering Acoustics (1); M.S. Leadership and Human Resource Development (1); M.S. Meteorology (1); M.S. Physics (1); M.S. Software Engineering (1); M.S. Systems Technology (1).
INTRODUCTION

Thesis
The thesis is the capstone achievement of the student’s academic endeavor at NPS. Thesis topics address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Students, with their faculty advisors, provide a very unique capability within the DoD for addressing warfighting problems. This capability is especially important at the present time when technology in general, and information operations in particular, are changing rapidly. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are rapidly being developed in both the commercial and military sectors. Their unique knowledge of operations, when combined with a challenging thesis project which requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet/Joint Force problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.

Figure 4. Classification of Theses
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ADVANCED DEGREES

Electrical Engineer
This thesis is part of an ongoing research project conducted at the Naval Postgraduate School. The goal of the project is to achieve the autonomous shipboard landing of Unmanned Aerial Vehicles (UAV). Two main problems are addressed in this thesis. The first is to effectively establish communication between the UAV’s ground station and the autonomous landing flight control computer. The second addresses the design and implementation of an autonomous landing controller using classical control techniques. Device drivers for the sensors and the communications protocol were developed in ANSI C. The overall system was implemented in a PC104 computer, running a real-time operating system developed by The Mathworks, Inc. Computer and hardware in the loop (HIL) simulation, as well as ground test results, show the feasibility of the algorithm proposed here. Flight tests are scheduled to be performed in the near future.

**KEYWORDS:** Unmanned Aerial Vehicles, UAV, Silver Fox, Autonomous Landing, Shipboard Landing, UAV Control System, Real Time Workshop, xPC Target, Piccolo
The purpose of this MBA project was to recommend force development solutions, in terms of capabilities, to meet the United States Army’s future utility helicopter requirements. The last thorough review of requirements for the utility helicopter fleet of the future was conducted in 2000. This project focuses on changes that have occurred in the Army since then, and the extent to which various alternative courses of action address those changes.

The report begins by briefly considering changes in the Army’s operational environment. Next, the authors consider what the requirements will be for the utility helicopter as the Army transitions from its current posture to the Objective Force. The study then considers possible materiel alternatives to fulfill the Objective Force requirements. These alternatives are to develop a new aircraft, use an aircraft that is already in production, or to improve the UH-60. The authors conclude that it is technically risky but feasible and cost effective to improve the UH-60 so that it can meet minimum future requirements, while a new aircraft acquisition option offers better performance and suitability at incrementally increasing costs.

**KEYWORDS:** UH-60, Black Hawk, Objective Force, Utility Helicopter, Utility Lift, Helicopter, Recapitalization, Acquisition, Requirements, Aerial Sustainment, Vertical Maneuver, EH101, H-92, Super Puma, CH

This thesis analyzes the impact of different educational credentials on first-term attrition by enlisted sailors in the U.S. Navy. For enlistment screening, the Navy currently categorizes applicants in one of three tiers according to educational attainment. These tiers form the basis of the Recruit Quality Matrix, which employs Armed Forces Qualification Test scores and educational credentials to determine enlistment eligibility. The analysis draws primarily from two sources: a Defense Manpower Data Center file containing enlisted cohorts from fiscal years 1989 through 1997 (to assess first-term attrition), and a Commander, Navy Recruiting Command data base containing enlisted cohorts from fiscal years 1998 through 2003 (to examine bootcamp attrition). Logit regression models are constructed using these data to identify differences in attrition propensities within the general tiers. A refined matrix is designed and
evaluated as a more accurate predictor of attrition. Further research is recommended to look at additional measures of success in service, such as performance, productivity, and promotion.

**KEYWORDS:** Navy, Attrition, Education, Credentials, Recruit, Matrix

**DEVELOPMENT OF A STEADY STATE MODEL FOR FORECASTING U.S. NAVY NURSE CORPS PERSONNEL**

Glenn G. Buni-Lieutenant, United States Navy  
B.S., Saint Mary’s College, 1993  
M.S., Saint Mary’s College, 1999  
Master of Business Administration-March 2004  
Gary T. Deen-Lieutenant, United States Navy  
B.S.N., Georgia State University, 1994  
Master of Business Administration-March 2004  
Advisors: Anke Richter, Defense Resources Management Institute  
Stephen L. Mehay, Graduate School of Business and Public Policy

This thesis developed a deterministic Markov state model to provide the U.S. Navy Nurse Corps a tool to more accurately forecast recruiting goals and future years force structure. Nurse Corps personnel were categorized by length of service and paygrade. The focus of this research was paygrades O-1 to O-3, which required lengths of service up to eleven years for aging through the system. O-4’s and O-5’s that appeared in the data were allowed to flow through the system. Nurse Corps data covering fiscal years 1990 to 2003 was provided by the Nurse Corps Community Manager’s office. The transition probabilities used in the Markov model were derived from the fiscal year data. Personnel stay at present grade, move up one grade, or exit the system within each year of the model. Backward movement was not allowed and individuals could only move up one grade per year. Logistic regression was then used to investigate the probability of “staying” in the Nurse Corps to certain career decision points. Nurse Corps cohort data files for fiscal years 1990 through 1994 were merged for analysis, as was cohort data for fiscal year 1996 through 1998. Results of the Markov model show that the O-1’s and O-2’s reach a steady state at the eight-year mark while the O-3’s reach a steady state at the seventeen-year mark (based on provided data). Comparing to Nurse Corps goals, the current accession plans result in a severe shortage of Lieutenants. There is an overabundance of Ensigns so the overall size of the Nurse Corps is as desired: it is just a more junior corps. Scenarios were developed to ascertain the best mix of accessions to attain Nurse Corps goals, as well as to examine scenarios for downsizing. Results of the logistic regression show that Recalls, Medical Enlisted Commissioning Program, and the Nurse Candidate Program were all significant at increasing the probability of staying in the Nurse Corps. Males were more likely than females to stay in the Nurse Corps and a change in education levels decreased the probability of staying in the Nurse Corps.

**KEYWORDS:** Nurse Corps Manpower, Markov Modeling, Accession Sources, FLORENCE, Manpower Planning, Steady State, Force Structure

**THE GLASS CEILING EFFECT AND ITS IMPACT ON MID-LEVEL FEMALE MILITARY OFFICER CAREER PROGRESSION**

Adrienne F. Evertson-Major, United States Marine Corps  
B.A., Norwich University, 1990  
Master of Science in Management-March 2004  
Amy M. Nesbitt-Captain, United States Air Force  
B.S., United States Air Force Academy, 1999  
Master of Business Administration-March 2004  
Advisors: Gail F. Thomas, Graduate School of Business and Public Policy  
Leslie E. Sekerka, Graduate School of Business and Public Policy

Women in the military are considered a minority population. Recent numbers reflect a 16% representation by women of the total Armed Forces population, with the Air Force displaying the largest proportion...
(17%), while the Marine Corps has the smallest proportion (6%). Multiple Defense organizations have expressed concern about the progression of women officers into senior leadership positions and the barriers they face to their continued success in the military.

This thesis explores the officer career path experienced by women officers progressing through the ranks, primarily during the mid-level grades of Captain (O-3) through Lieutenant Colonel (O-5). It specifically examines women in the United States Marine Corps and Air Force because these two branches of service currently maintain the smallest and largest proportion of women, respectively. Researchers examined the demographic composition of the individual service communities and conducted personal interviews with mid-level (O-3 to O-5) and senior (O-6 and above) officers to investigate any commonalities paralleling the military to the civilian sector. Specifically, this inquiry looks at the “glass ceiling” effect and any strong similarities or differences that may exist between the Marine Corps and the Air Force. Resulting information is expected to reveal a better understanding of military women’s career progression and factors that may exist in today’s Armed Services which influence their decision to continue or separate from the military.

KEYWORDS: Glass Ceiling, Career Progression, Women in the Military

COST ANALYSIS FOR THE DEVELOPMENT AND OPERATION OF THE NEMESIS PROJECT

Jeffery S. Lock-Lieutenant, United States Navy
Master of Business Administration-March 2004
John B. Weber-Lieutenant, United States Navy
Master of Business Administration-September 2004
Advisors: Brian D. Steckler, Department of Information Sciences
George W. Thomas, Graduate School of Business and Public Policy
Juliette A. Webb, Graduate School of Business and Public Policy

The primary objective of the Nemesis program is to provide a mobile wireless research facility for Federal agencies and other authorized agencies. The report provides estimates of the Nemesis program’s original cost, replication cost, scheduled costing for operational requirements, and budgeting guidelines. The report provides future funding request justification for both labor and equipment lifecycle costs. The report also provides the program funding agencies a more precise cost benefit analysis, to project future operating costs, and to provide standardized budget guidelines. The estimate of the original cost includes equipment acquisitions, software and reference material acquisition, inventory validation, billed labor, estimated non-billed labor, estimated non-billed infrastructure support, billed training and certification, estimated project management, and estimated administrative support. The estimate of the original cost does not include legal support and governmental administrative requirements. The replicating cost is determined from the original cost with discovery costs removed. The discovery cost includes initial research/evaluation of alternate methods of system implementation, reduced expertise in labor due to documented replicating procedures, and an improved training process for operators. The costing schedule is based on the projected program-operating tempo. The budgeting guidelines provide the budget format, target parameters for inventory, and capital reinvestment to offset depreciation expenses.

The authors examine the history of immigrant military service in the United States, explore the motivations of non-citizen enlistees, and analyze the military performance of non-citizens relative to that of citizen enlistees. Information sources include a comprehensive review of literature, focused interviews with a small sample of non-citizen enlistees, and cohort data files of enlisted personnel who entered the military from 1990 through 1998. The history of non-citizen service corresponds roughly to the nation’s history of immigration and naturalization policy, with military service having offered immigrants economic benefits, as well as a path toward assimilation. Service by non-citizens has also provided the country a way to meet its military manpower needs. The results of statistical analyses suggest non-citizens have lower predicted rates of first-term attrition, and higher estimated rates of retention beyond the first term and promotion to E-4. The authors conclude that non-citizens provide a valuable source of manpower, and fulfill important and influential roles for the next generation. Thus, it may be worthwhile to provide non-citizens more information about enlistment opportunities and to implement unique reenlistment incentives, including expedited green-card status for family members. Future research should examine specific ethnic categories of interest within the population of non-citizens.

KEYWORDS: Non-citizens, Immigrants, Latinos, Mexicans, Asian/Pacific Islanders, Filipinos, Enlistees, First-Term Enlistees, Attrition, Retention, Promotion

UTILITY OF COMPUTER MODEL FOR DETAILING

As the Navy and the DoD focus on technology and training to provide a lean, well-trained, and capable military response force, it becomes imperative that the occupational training received by Navy personnel is optimally utilized by placing them in jobs that make use of their training to meet fleet mission requirements. Optimized sailor assignments that meet command requirements would better meet the utility function of the labor supplied to match the labor demanded within the labor market, i.e., the optimal match of sailors and command billet qualities.

This research provides a quantitative analysis to compare the Navy’s current detailing process to a proposed information technology (IT) matching algorithm process. The purpose is not to summarily prove that an IT program is better than the current human detailing process, but to demonstrate quantitatively, using an IT matching algorithm, that both sailor and command utilities can be better satisfied. Thus, enhancing Sea Warrior in creating a stable labor market where both the needs of sailors’ and commands’ are met in support of Sea Power 21 and Joint Vision 2020.

KEYWORDS: Detailing, Pareto Optimal, Labor Markets, Labor Supply, Labor Demand, Two-Sided Matching
MASTER OF SCIENCE

Applied Physics
Astronautical Engineering
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Information Systems and Operations
Information Technology Management
Leadership and Human Resource Development
Management
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physics
Software Engineering
Systems Engineering
Systems Technology
When a burst of air is produced in water, the result can be a toroidal bubble. This thesis is concerned with experimental investigations of three acoustical properties of toroidal bubbles: (i) propagation through high-intensity noise, (ii) emission, and (iii) scattering. In (i), an attempt to observe a recent prediction of the acoustic drag on a bubble is described, which is analogous to the Einstein-Hopf effect for an oscillating electric dipole in a fluctuating electromagnetic field. No effect was observed, which may be due to insufficient amplitude of the noise. In (ii), observations of acoustic emissions of volume oscillations of toroidal bubbles are reported. Surprisingly, the emission occurs primarily during the formation of a bubble, and is weak in the case of very smooth toroidal bubbles. In (iii), an experiment to observe the effect of a toroidal bubble on an incident sound field is described. In addition to the acoustical investigations, the construction of a large hallway apparatus for further investigations and for hands-on use by the public is described. The tank has cross section two feet by two feet and height six feet, and the parameters of reservoir pressure and time between air bursts are adjustable by the observer.

**KEYWORDS:** Toroidal Bubble, Acoustic Emission, Vortex Ring
HALO ORBIT DESIGN AND OPTIMIZATION
Gina L. McCaine-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Astronautical Engineering-March 2004
Advisors: I. Michael Ross, Department of Mechanical and Astronautical Engineering
Don Danielson, Department of Applied Mathematics

A Halo orbit about a libration point of a restricted three-body system provides additional opportunities for surveillance, communication, and exploratory missions in lieu of the classical spacecraft orbit. Historically, libration point missions have focused on Halo orbits and trajectories about the Sun-Earth System. This thesis will focus on libration point orbit solutions in the Earth-Moon System using the restricted three body equations of motion with three low-thrust control functions. These classical dynamics are used to design and optimize orbital trajectories about stable and unstable libration points of the Earth-Moon system using DIDO, a dynamic optimization software. The solutions for the optimized performance are based on a quadratic cost function. Specific constraints and bounds were placed on the potential solution set in order to ensure correct target trajectories. This approach revealed locally optimal solutions for orbits about a stable and unstable libration point.

KEYWORDS: Halo Orbit, DIDO, Lagrange Point, Libration Point, Optimization
MASTER OF SCIENCE
IN
COMPUTER SCIENCE

DESIGN AND DEVELOPMENT OF A WEB-BASED DOD PKI COMMON ACCESS CARD (CAC) INSTRUCTION TOOL

Vasileios Athanasopoulos-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1990
Master of Science in Computer Science-March 2004
Master of Science in Information Technology Management-March 2004
Advisors: Cynthia Irvine, Department of Computer Science
J.D. Fulp, Department of Computer Science
Second Reader: Glenn Cook, Department of Information Sciences

Public-Key Cryptography and the infrastructure that has been designed to successfully implement it: Public Key Infrastructure (PKI) is a very promising computer security technology. As a significant enhancement to this infrastructure, the DoD is now issuing smart card tokens, in the form of the Common Access Card (CAC), to its service members. This card is a relatively complex cryptographic device that contains its user’s private keys, digital certificates, and other personal/administrative information. These cards are issued to service personnel with little or no training regarding what they are or how they function. Such an omission detracts from the infrastructure’s overall security. This thesis presents an introductory-level description of public key cryptography and its supporting infrastructure (PKI). The thesis then goes on to develop a web-based training tool that could provide all DoD CAC holders with the rudimentary knowledge of how their CAC fits into the broader infrastructure. The training tool will require no instructor, and will present a validation test to each user. DoD commands could utilize this tool to provide basic CAC training to their members.

KEYWORDS: Cryptography, Symmetric Cryptography, Asymmetric Cryptography, Public Key, Private Key, Public Key Infrastructure, PKI, DoD PKI, Certificate, Certificate Authority, CA, Local Registration Authority, LRA, Common Access Card, CAC, Web-based Tutorial

FULL-DUPLIC NETWORKING USING CDMA

Kurtulus Bektas-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1997
Master of Science in Computer Science-March 2004
Advisor: Geoffrey G. Xie, Department of Computer Science
Second Reader: John H. Gibson, Department of Computer Science

Establishing a full-duplex underwater network, researching and applying a CDMA protocol to this network, providing a recommendation for a full-duplex underwater network, and providing recommendations for using CDMA to increase the efficiency of this network are the general scope of this thesis.

A connection that allows traffic in both directions simultaneously underwater is an example of full-duplex communication. Compared to a half duplex configuration, the full duplex network underwater may provide a better networking environment. Currently, most Underwater Acoustic Networks (UANs) still utilize half-duplex network communication. CDMA is the third kind of channel partitioning protocol. Most of the wireless communication devices utilize different kinds of CDMA protocol as a reliable and faster communication. The research conducted in establishing a full-duplex UAN using CDMA may provide reliable and faster communication compared to half-duplex.

KEYWORDS: Full-Duplex, Half-Duplex, CDMA, Spread Spectrum, Acoustic Modem, Underwater Acoustic Networks, Temperature, Salinity, Pressure, Noise, Multipath
This thesis is primarily concerned with automation support for an organization in charge of the construction and modification of buildings for military bases and civilian construction during disaster relief.

The first issue at hand is the need to know how an organization functions manually and the participation of each department in daily work. The Use Cases Analysis was applied to understand the business process and a Unified Modeling Language (UML) model was created to appraise the domain concepts. Architecture for a decision support system was then developed to provide the necessary automation support and a prototype for the user interface of the proposed system.

The proposal software will improve the decision-making ability of the leader of an organization and the heads of each department. It will make the routine tasks easier, and provide necessary and accurate data in a timely manner.

**KEYWORDS:** Automation Support, COBOL, Construction

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**NETWORK PROCESSORS AND UTILIZING THEIR FEATURES IN A MULTICAST DESIGN**

Timur Diler-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1998
Master of Science in Computer Science-March 2004
Master of Science in Electrical Engineering-March 2004
Advisors: Wen Su, Department of Computer Science
Jon Butler, Department of Electrical and Computer Engineering

In order to address the requirements of the rapidly growing Internet, network processors have emerged as the solution to the customization and performance needs of networking systems. An important component in a network is the router, which receives incoming packets and directs them to specific routes elsewhere in the system. Network processors and the associated software control the routers and switches and allow software designers to quickly deploy new systems, such as a multicasting forwarder and firewalls.

This thesis introduces network processors and their features, focusing on the Intel IXP1200 network processor. A multicast design for the IXP1200 using microACE is proposed.

This thesis presents an approach to building a multicasting forwarder using the IXP1200 network processor layer 3 forwarder microACE that carries out unicast routing. The design is based on the Intel Internet exchange architecture and its active computing element (ACE). The layer 3 unicast forwarder microACE is used as a basic starting point for the design. Some software modules, called microblocks, are modified to create a multicast forwarder that is flexible and efficient.

**KEYWORDS:** IXP1200, Multicasting, ACE, Microace, Network Processors, Intel IXA, Microengine

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**DEVELOPING AN AFTER ACTION REVIEW SYSTEM FOR A 3D INTERACTIVE TRAINING SIMULATION USING XML**

Dimitrios E. Filiagos-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Master of Science in Computer Science-March 2004
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Rudolph P. Darken, Modeling, Virtual Environments, and Simulation Institute
CDR Joseph A. Sullivan, USN, Department of Computer Science

An important capability that many modern 3D interactive training simulations lack is an After Action Review System (AARS) that helps both the trainer and the trainee conduct an After Action Review (AAR). Although AAR is not a new idea in the 3D simulation field, it is not widely used in training simulations. In
real life training, AAR has proven to be one of the most important phases of the training procedure, sometimes taking the form of debriefing, or in other cases, by conducting a deeper analysis and discussion of the facts. In order to conduct an AAR, a well-designed system must exist to keep track of the conditions and the actions during an exercise, so they can be available for review later. This thesis translates the idea of AAR for real training situations to the 3D interactive simulation domain and also develops an After Action Review System (AARS) using XML technology for capture, analysis, and interactive playback of an entire simulation training session. Users can change the point of view to any desired position and direction, something that is impossible in video streaming playbacks.

KEYWORDS: After Action Review, After Action Discussion, Capture, Playback, Platform, Platform Path, HLA, Federation

HIGH SPEED NETWORK ACCESS TO THE LAST-MILE USING FIXED BROADBAND WIRELESS

Nikolaos Fougias-Lieutenant Junior Grade, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Master of Science in Information Technology Management-March 2004
Master of Science in Computer Science-March 2004
Advisors: Gilbert M. Lundy, Department of Computer Science
Thomas Housel, Department of Information Sciences

Despite the increase in the demand for high speed Internet services, the last-mile solutions currently available are either too expensive to attract the majority of the population or not available in low density populated areas. This thesis examines Fixed Broadband Wireless (FBW) as an alternative technology to the current last-mile solutions. The analysis shows that the Local Multipoint Distribution System (LMDS) and the Multichannel Multipoint Distribution Service (MMDS) are the most promising emerging FBW technologies and that they are able, by utilizing microwave radio as their fundamental transport medium and using high modulation schemes, to provide digital two-way voice, data, video, and Internet services.

This thesis shows that both technologies are constrained by free space loss and line-of-sight impairments, with rain absorption being the most significant cause of attenuation in the case of LMDS, while vegetation and multipath fading play a significant role mostly in the case of MMDS. Additionally, it is shown that there is a positive association between the data rate achieved and the level of influence due to Additive White Gaussian Noise (AWGN). Based on the analysis and using coverage areas, total capacity, achieved data rates, weather and line-of-sight limitations, and cost as the most important criteria, it is concluded that LMDS is a preferable solution for enterprise end-users in densely populated urban areas outside the reach of fiber networks, while MMDS targets residential end-users in rural or suburban areas that are not able to receive service through high-speed wireline connections.

KEYWORDS: LMDS, MMDS, OFDM, Line-of-Sight, Fresnel Zones, Additive White Gaussian Noise, Bit Error Rate

SCRIPTING QUALITY OF SECURITY SERVICE (QOSS) SAFEGUARD MEASURES FOR THE SUGGESTED INFOCON SYSTEM

Jennifer A. Guild-DoD Civilian
B.S., California Lutheran University, 1997
Master of Science in Computer Science-March 2004
Advisors: George W. Dinolt, Department of Computer Science
J.D. Fulp, Department of Computer Science

The existing INFOCON system is an information warning system that the DoD maintains. It is not formally correlated to other warning systems, such as DEFCON, FCON/THREATCON, WATCHCONs, SANS INFOCON, or the Homeland Security Advisory System Threat condition. The criteria for each INFOCON level are subjective. The INFOCON recommended actions are a mix of policy and general technical measures. The INFOCON system vaguely follows the Defense-in-Depth network defense methodology.
COMPUTER SCIENCE

This thesis examines the foundations for the existing INFOCON system and presents an evolved INFOCON system. The focus will be on the security of the DoD information infrastructure and accomplishing the mission, as well as the usability and the standardization of the INFOCON warning system. The end result is a prototype that is a set of predefined escalation scripts for the evolved INFOCON system’s safeguard measures.

KEYWORDS: DEFCON, FPCON, THREATCON, WATCHCONs, SANS INFOCON, DOD, Defense-in-Depth, INFOCON, Information, Information Assurance, Actions, Measures, Perimeter Security

DESIGN AND ANALYSIS OF A MODEL RECONFIGURABLE CYBER-EXERCISE LABORATORY (RCEL) FOR INFORMATION ASSURANCE EDUCATION
R. James Guild-DoD Civilian
B.S., MMIS
Master of Science in Computer Science-March 2004
Advisors: Cynthia Irvine, Department of Computer Science
Second Reader: J.D. Fulp, Department of Computer Science

This thesis focuses on the practice of teaching computer and information security in a specially designed laboratory, and on fulfilling the need of the government and academia to establish computer security training laboratories with minimal equipment, while achieving a very high level of experiential learning. This thesis will demonstrate the utility of a reconfigurable cyber-exercise laboratory (RCEL). The work shows several laboratory network topologies, discusses the underlying computer security and information assurance principles, and shows several ways to configure an RCEL for defensive and offensive information security education. The thesis presents detailed learning objectives for activities in the laboratory. Multiple exercise scenarios are presented which can be adapted to educational and training facilities operated by the U.S. government or secular academic institutions.

KEYWORDS: Cyber-Exercise, Laboratory, Information Assurance, Education, Learning Objectives, Exercise Scenario, Teaching Model, Information Assurance Laboratory Model

TOWARD MANAGING AND AUTOMATING CYBERCIEGE SCENARIO DEFINITION FILE CREATION
Kenneth W. Johns, Jr.- Civilian, Federal Cyber Service Corps
B.S., California State University Bakersfield, 2002
Master of Science in Computer Science-March 2004
Advisors: Cynthia Irvine, Department of Computer Science
Paul Clark, Department of Computer Science
Second Reader: Mike Thompson, Aesec Corporation

The CyberCIEGE project seeks to create an alternative to traditional Information Assurance (IA) training and education approaches by developing an interactive, entertaining, commercial-grade PC-based computer game/virtual laboratory. CyberCIEGE will provide a robust, flexible, and extensible gaming environment where each instance of the game is based on a fully customizable scenario. These scenarios are written in the CyberCIEGE Scenario Definition Language. Unfortunately, the trade-off for flexibility, extensibility, and fully customizable scenarios is syntax complexity in the scenario definition language.

This thesis will solve this real world problem by showing that the complexity of scenario definition language syntax can be managed through a software tool. This thesis will develop such a tool and further demonstrate that progress can be made toward automating scenario generation.

KEYWORDS: Information Assurance, CyberCIEGE, Syntax Complexity Management
COMPUTER SCIENCE

NPS AUV WORKBENCH COLLABORATIVE ENVIRONMENT FOR AUV MISSION PLANNING AND 3D VISUALIZATION
Chin Siong Lee-Civilian, Singapore
B.S., Nanyang Technological University-Singapore, 1995
Master of Science in Computer Science-March 2004
Advisors: Donald P. Bruzman, Department of Information Sciences
Curtis L. Blais, Modeling, Virtual Environments, and Simulation Institute
Second Readers: John Hiles, Department of Computer Science
LCDR Duane T. Davis USN, Modeling, Virtual Environments, and Simulation Institute

The absence of common software platforms for Autonomous Underwater Vehicle (AUV) mission planning and analysis is an ongoing impediment to collaborative work between research institutions, their partners, and end users. This thesis details the design and implementation of a distributable application to facilitate AUV mission planning and analysis. Java-based open-source libraries and a component-based framework provide diverse functionalities. The Extensible Markup Language (XML) is used for data storage and message exchange, Extensible 3D (X3D) Graphics for visualization, and XML Schema-based Binary Compression (XSBC) for data compression. The AUV Workbench provides an intuitive cross-platform-capable tool with extensibility to provide for future enhancements such as agent-based control, asynchronous reporting and communication, loss-free message compression, and built-in support for mission data archiving.

This thesis also investigates the Jabber instant messaging protocol, showing its suitability for text and file messaging in a tactical environment. Exemplars show that the XML backbone of this open-source technology can be leveraged to enable both human and agent messaging with improvements over current systems. Integrated Jabber instant messaging support makes the NPS AUV Workbench the first custom application supporting XML Tactical Chat (XTC).

Results demonstrate that the AUV Workbench provides a capable testbed for diverse AUV technologies, assisting in the development of traditional single-vehicle operations and agent-based multiple-vehicle methodologies. The flexible design of the Workbench further encourages integration of new extensions to serve operational needs. Exemplars demonstrate how in-mission and post-mission event monitoring by human operators can be achieved via simple web page, standard clients, or custom instant messaging client. Finally, the AUV Workbench’s potential as a tool in the development of multiple-AUV tactics and doctrine is discussed.

KEYWORDS: AUV Workbench, XML-Based Mission Control Script, Jabber Instant Messaging

DEPLOYABLE COMBAT SIMULATIONS VIA WIRELESS ARCHITECTURES
Jeffrey S. Lock, Sr.-Lieutenant, United States Navy
B.S., Hawaii Pacific University, 2001
Master of Science in Computer Science-March 2004
Advisors: Rudolph P. Darken, Department of Computer Science
CDR Joseph A. Sullivan, USN, Department of Computer Science

This thesis details the critical need for deployable combat simulations for training in today’s surge force environment. To truly realize deployment of these simulations on Naval vessels and in remote theaters, simulations for training must be wireless. Wireless standards 802.11/a/b/g are presented in detail to highlight the strengths and weaknesses of each. This thesis then investigates the viability of deploying combat simulations for training using wireless devices. To this end, the Joint Semi-Automated Forces (JSAF) combat simulation model and the Virtual Helicopter (VEHELO) training simulation entity are tested in an 802.11a wireless environment against the VEHELO application in a wired environment. 802.11a is proposed as part of an overall solution to deploy combat simulations for training. This is primarily because of its high data rates and ability to co-locate access points without interference. Testing reveals that operating JSAF and Virtual Helicopter via the High Level Architecture (HLA) with User Datagram Protocol (UDP) packets in an 802.11a environment provides ample bandwidth with which to deploy combat simulation for training for the simulations conducted.

KEYWORDS: JSAF, HLA, RTI, Wireless, Simulation, Training, VEHELO, UDP

NPS • Winter Quarter • March 2004
Modern technology is making virtual environments a part of daily life. However, some constraints regarding the use of virtual environments, such as the need for high performance and well-configured computers, prevent users from accessing virtual environments in places other than special computer rooms. Mobile devices may be used to solve this limitation in a virtual environment.

The remote-control approach to access virtual worlds on the Internet or on a corporate network is a new concept that opens new doors to users. The first step of this approach is already in use, such as games implemented for mobile devices using the screen of a mobile device as display, and has given satisfying results for some users. This research will take the user, who not only wants to be mobile but also does not want to sacrifice high resolution textures and complex models, closer to his/her goal.

Mobile devices provide mobility to the user, but sacrifice not only the reality of the virtual environments, but also screen size, which is very important for visibility of complex virtual environments. The hybrid approach with wireless internet connection by using mobile devices as remote control gives the user the advantages of mobility over desktop PCs. On the other hand, the realism provided by high-quality PCs on the server side exceeds the capabilities of mobile devices.

**KEYWORDS:** Wireless, Wireless Ethernet 802.11, Bluetooth, Collaboration, Mobile Devices, Remote Control, Virtual Environment, X3D, VRML, Chess Game, Pocket PC, Pocket PC Cortona, Mobility, Reality, Java Application, Web-Services

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Inter-domain routing connects individual pieces of Internet topology, creating an integral, global data delivery infrastructure. Currently, this critical function is performed by the Border Gateway Protocol (BGP) Version 4 [RFC1771]. Like all routing protocols, BGP is vulnerable to instabilities that reduce its effectiveness. Among the causes of these instabilities are those which are maliciously induced. Although there are other causes, e.g., natural events and network anomalies, this thesis will focus exclusively on maliciously induced instabilities. Most current models attempting to predict a BGP routing instability confine their focus to either macro- or micro-level metrics, but not to both. The inherent limitations of each of these forms of metric gives rise to an excessive rate of spurious alerts, both false positives and false negatives. It is the original intent of this thesis to develop an improved BGP instability prediction model by statistically combining BGP instability metrics with user level performance metrics. The motivation for such a model is twofold: (i) to provide sufficient prior warning of impending failure to facilitate proactive protection measures, and (ii) to improve warning reliability beyond existing models, by demonstrably reducing both false positives and false negatives. However, the analysis of actual network trace data shows that a widely used BGP instability metric, the total number of update messages received in a time period, is not a good indicator of future user level performance.

**KEYWORDS:** Catastrophic BGP Routing Instabilities, Macro-Level and Micro-Level Metrics Correlation, Worm Attack Studies

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Wireless Local Area Network (WLAN) technologies are becoming widely used since they provide more flexibility and availability. Unfortunately, it is possible for WLANs to be implemented with security flaws which are not addressed in the original 802.11 specification. IEEE formed a working group (TGi) to provide a complete solution (code named 802.11i standard) to all the security problems of the WLANs. The group proposed using 802.1X as an interim solution to the deficiencies in WLAN authentication and key management. The full 802.11i standard is expected to be finalized by the end of 2004.

Although 802.1X provides a better authentication scheme than the original 802.11 security solution, it is still vulnerable to denial-of-service, session hijacking, and man-in-the-middle attacks. Using an open-source 802.1X test-bed, this thesis evaluates various session hijacking mechanisms through experimentation. The main conclusion is that the risk of session hijacking attack is significantly reduced with the new security standard (802.11i); however, the new standard will not resolve all of the problems. An attempt to launch a session hijacking attack against the new security standard will not succeed, although it will result in a denial-of-service attack against the user.

KEYWORDS: Wireless Local Area Networks, Authentication, Security, Session Hijacking, 802.1X, 802.11i, Encryption, Access Control, Suppliant, Authenticator, Authentication Server, Open-source Test-bed

Users are adopting the latest Wireless Local Area Network (WLAN) technology for convenience and to save time and costs of network deployments. In some cases, WLANs are the only cost-effective solutions in providing high-speed network access to users. However, there are security concerns with WLANs that must be considered when deploying them over critical infrastructures, such as military and administrative government LANs.

The IEEE 802.11 WLAN standard specifies both an authentication service and an encryption protocol, but research has demonstrated that these protocols are severely flawed. The discovery has led to the formation of a new IEEE workgroup (IEEE 802.11i) to develop the next generation WLAN standards that will address all known 802.11 security vulnerabilities. The workgroup proposed using the IEEE 802.1X Port-Based Network Access Control Standard as an interim measure to meet the security requirements of the WLANs until the workgroup is finished with the new specifications.

Using an open-source test-bed for evaluating Denial of Service (DoS) attacks on WLANs, this research demonstrates four different DoS attacks that verify the weaknesses of the IEEE 802.1X protocol. Potential solutions to mitigate the effects of such DoS attacks are also evaluated.

KEYWORDS: Wireless Local Area Networks, Security, Denial of Service Attacks, 802.1X Security Protocol, Open Source Test Bed
AUTONOMOUS AGENT-BASED SIMULATION OF A MODEL SIMULATING THE HUMAN AIR-THREAT ASSESSMENT PROCESS
Baris Egemen Ozkan-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1998
Master of Science in Computer Science-March 2004
Advisors: John Hiles, Department of Computer Science
Neil Rowe, Department of Computer Science
Second Reader: Chris Darken, Department of Computer Science

The Air Defense Laboratory (ADL) Simulation is a software program that models the way an air-defense officer thinks in the threat assessment process. The model uses Multi-Agent System (MAS) technology and is implemented in Java programming language. This research is a portion of Red Intent Project, whose goal is to ultimately implement a model to predict the intent of any given track in the environment. For any air track in the simulation, two sets of agents are created, one for controlling track actions and one for predicting its identity and intent based on information received from track, the geopolitical situation and intelligence. The simulation is also capable of identifying coordinated actions between air tracks. Three kinds of aircraft behavior were used in the simulation: civilian, friendly, and enemy. Predictor agents are constructed in a layered structure and use “conceptual blending” in their decision-making processes, using mental spaces and integration networks. Mental spaces are connected to each other via connectors and connectors trigger tickets. Connectors and tickets were implemented using the Connector-based Multi Agent System (CMAS) library. This simulation is one of the first applications to use cognitive blending theory for a military application. It was demonstrated that agents can create an “integration network” composed of “mental spaces” and retrieve any mental space data inside the network immediately, without traversing the entire network by using the CMAS library. The results of the tests of the simulation showed that the ADL simulation can be used as an assistant to human air-defense personnel to increase accuracy and decrease reaction time in naval air-threat assessment.

KEYWORDS: Air Defense Laboratory Simulation, Naval Air-threat Assessment, Air-defense, Conceptual Blending Theory, Air-defense Simulation, Multi Agent Systems

RELIABLE CONTENT DELIVERY USING PERSISTENT DATA SESSIONS IN A HIGHLY MOBILE ENVIRONMENT
Periklis K. Pantoleon-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Master of Science in Computer Science-March 2004
Advisors: Wen Su, Department of Computer Science
John H. Gibson, Department of Computer Science

Special Forces are crucial in specific military operations. They usually operate in hostile territory where communications are difficult to establish and preserve, since the operations are often carried out in a remote environment and the communications need to be highly mobile. The delivery of information about the geographical parameters of the area can be crucial for the completion of the mission. But in that highly mobile environment, the connectivity of the established wireless networks (LANs) can be unstable and intermittently unavailable.

Existing content transfer protocols are not adaptive to volatile network connectivity. If a physical connection is lost, any information or part of a file already retrieved is discarded and the same information must be retransmitted again after the re-establishment of the lost session. The intention of this thesis is to develop a protocol in the application layer that preserves the already transmitted part of the file, and when the session is re-established, the information server can continue sending the rest of the file to the requesting host. Further, if the same content is available from another server through a better route, the new server should be able to continue to serve the content, starting from where the session with the previous server ended.

KEYWORDS: File Transfer Protocol, Partial File Retrieval, SFTP, TFTP, HTTP
Popular software for high assurance systems is not readily available. Developers do not want to develop or port applications for secure systems because of the perception that high assurance development is too time consuming, in some cases impossible, and that performance is inadequate. This trend must be stopped by demonstrating that if an intelligent approach to porting software is used, then the development costs will be acceptable.

The Network File System (NFS) service, which is a rather complex module that provides widely used functionality for file sharing, has been ported to the XTS-400 to show that a port can be completed in a timely manner and to assess the challenges of development for a multilevel system. Porting starts by analyzing the major requirements of the software and of the target system, and then proceeds to developing an approach for tackling the port.

The hardest part of porting is the learning curve required to understand the target system and the software to be ported. Once this is accomplished, then porting becomes straightforward. Tests demonstrated that remote clients were able to access shared files on the NFS server. The XTS-400 now has the capability to share files through the popular NFS protocol.

**KEYWORDS:** Network File System, XTS-400, Multilevel Secure, High Assurance, Porting

Free Space Optics (FSO) technology is an alternative broadband technology which provides fast, secure, and reliable data transmission. The FSO systems are being used for commercial systems between fixed sites and are being considered for military systems because of their inherent benefits, which are security and high data rates. In military communications, security is the first priority. The small divergence of the laser beam makes FSO systems more secure than the existing radio frequency (RF) based wireless systems, because it is highly difficult to detect and intercept a laser beam due to the nature of the laser and the small divergence angle of the transmitter. However, FSO implementation on mobile platforms such as ships is still challenging.

This thesis analyzes the feasibility of deploying an FSO systems on Navy surface ships. FSO technology and the latest studies in maritime optical communication links are discussed. In addition, the benefits and challenges of FSO technology specific to this study are analyzed. The final section discusses the systems required to improve the performance of FSO systems on ships. The thesis concludes that FSO technology, while not ready for deployment, looks very promising for the near future.

**KEYWORDS:** Free Space Optics, FSO, Laser Communication, Navy, Ship
The need for broadband network access is experiencing rapid growth, but what is currently available is not sufficient. Copper-based technologies cannot address the requirements of today’s bandwidth-intensive Internet applications. End-users in the “last mile” demand access speeds equivalent to those supported by fiber optics backbone networks, although the cost and time associated with its installation are prohibitive factors for bringing fiber to every home and business. This results in the well-known “last mile access problem,” which prevents the Internet from reaching its full potential and has paved the way for the development of many innovative technologies. Driven by demands for more bandwidth, wireless broadband technologies have been proposed.

This thesis provides an investigation of two candidates to address the lack of adequate bandwidth in the “last mile,” Free Space Optics (FSO) and the IEEE 802.11 Wireless Local Area Networking (WLAN) standard. FSO uses optical signals to deliver information at extremely high data rates, more quickly and cost-effectively than fiber systems. The IEEE 802.11 standard uses radio technology to transfer data. They both use license-free frequency bands for transmission through the atmosphere. They both are quickly deployable, easily scalable, and cheaper than wired solutions, characteristics able to support applications requiring high bandwidth and a high degree of mobility.

**KEYWORDS:** Broadband Network Access, Last Mile, FSO, Free Space Optics, WLAN, Wireless Local Area Networking, IEEE 802.11, High Bandwidth, Wireless Broadband Technologies, Fiber Optics
In this thesis, the impact of acquisition reform on small businesses in the Federal procurement arena is examined. The thesis traces the origins of acquisition reform and examines acquisition reform legislation. The thesis also details the major laws and regulations that govern small business participation in the Federal procurement arena. The results of a survey of small businesses are presented in order to show first hand how small businesses have been effected by acquisition reform.

KEYWORDS: Acquisition Reform, Small Business, Contracting, Contract Bundling, Electronic Commerce, Multiple Award Schedules, Reverse Auctions
MONITORING THE PROGRESS OF THE NAVY MARINE CORPS INTRANET (NMCI):
IMPLEMENTATION, PERFORMANCE, AND IMPACT
Dimitrios Dalakis-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1992
Master of Science in Information Technology Management-March 2004
Master of Science in Defense Analysis-March 2004
Advisor: Glenn Cook, Department of Information Sciences
Second Reader: Dorothy E. Denning, Department of Defense Analysis

Information superiority is the motivation for the creation of the Global Information Grid (GIG) as the means to provide connectivity between all parts of shore establishments and with all deployed forces at sea and ashore. The Navy Marine Corps Intranet (NMCI) is an Information Technology (IT) services contract to provide secure universal access to integrated voice, video, and data communications; eliminate interoperability problems; and remove network impediments to improve productivity and speed of command to the shore-based components of the Navy and Marine Corps.

The NMCI contract is the procurement of IT services based on a commercial model of Service Level Agreements (SLAs). Under this model, the emphasis is placed on the verification, validation, and monitoring of the end-user services and not on the underlying infrastructure of systems.

This research explores the current implementation effort of NMCI and analyzes the way this common network capability is tested and monitored. This thesis will provide a single source of information for managers seeking to quickly understand the impact of NMCI as an enterprise level asset. Security policies related to the project are examined and recommendations to improve this new IT initiative are made.

KEYWORDS: Navy Marine Corps Intranet, NMCI, Information Assurance, FORCEnet, IT Services

THE ART OF RIVERINE WARFARE FROM AN ASYMMETRICAL APPROACH
Paul F. Willey-Lieutenant Commander, United States Navy
B.S., University of Mississippi, 1990
Master of Science in Defense Analysis-March 2004
Advisor: Anna Simons, Department of Defense Analysis
Second Reader: George Lober, Department of Defense Analysis

This thesis examines U.S. riverine warfare from an unconventional perspective in three Latin American countries: Bolivia, Colombia, and Peru. U.S. forces, in particular Naval Surface Warfare (NSW), was (and remains) instrumental in helping these countries establish riverine units and an active presence on their rivers. These three different programs all have the same mission: to deny the uncontested use of the rivers and inland waterways by narco traffickers and insurgent forces for the use of illegal activities. This thesis compares and contrasts the three cases and garnishes lessons learned for future similar endeavors.

KEYWORDS: Rivers, Riverine, Narco Traffickers, Narco Terrorists, Insurgency and Lawlessness
In order to address the requirements of the rapidly growing Internet, network processors have emerged as the solution to the customization and performance needs of networking systems. An important component in a network is the router, which receives incoming packets and directs them to specific routes elsewhere in the system. Network processors and the associated software control the routers and switches and allow software designers to quickly deploy new systems, such as a multicasting forwarder and firewalls.

This thesis introduces network processors and their features, focusing on the Intel IXP1200 network processor. A multicast design for the IXP1200 using microACE is proposed.

This thesis presents an approach to building a multicasting forwarder using the IXP1200 network processor layer 3 forwarder microACE that carries out unicast routing. The design is based on the Intel Internet exchange architecture and its active computing element (ACE). The layer 3 unicast forwarder microACE is used as a basic starting point for the design. Some software modules, called microblocks, are modified to create a multicast forwarder that is flexible and efficient.

**KEYWORDS:** IXP1200, Multicasting, ACE, Microace, Network Processors, Intel IXA, Microengine

Orthogonal frequency division multiplexing (OFDM) is being successfully used in numerous applications. It was chosen for the IEEE 802.11a wireless local area network (WLAN) standard, and it is being considered for the fourth-generation mobile communication systems. Along with its many attractive features, OFDM has some principal drawbacks. Sensitivity to frequency errors is the most dominant of these drawbacks. In this thesis, the frequency offset and phase noise effects on OFDM based communication systems are investigated under a variety of channel conditions covering both indoor and outdoor environments. The simulation performance results of the OFDM system for these channels are presented.

**KEYWORDS:** OFDM, Frequency Offset, Phase Noise, Differential Decoding, IFFT, Inverse Fast Fourier Transform, Guard Interval, FFT, MATLAB, Additive White Gaussian Noise, AWGN, Interleaver, Deinterleaver, Mobile Channels, Convolutional Encoding, Viterbi Decoder, Probability of Bit Error, Wiener Process
PERFORMANCE ANALYSIS OF THE IEEE 802.11A WLAN STANDARD OPTIMUM AND SUB-OPTIMUM RECEIVER IN FREQUENCY-SELECTIVE, SLOWLY FAADING NAKAGAMI CHANNELS WITH AWGN AND PULSED NOISE JAMMING
Christos Kalogrias-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1994
Master of Science in Electrical Engineering-March 2004
Master of Science in Systems Engineering-March 2004
Advisors: R. Clark Robertson, Department of Electrical and Computer Engineering
Donald V.Z. Wadsworth, Department of Electrical and Computer Engineering
and Space Systems Academic Group

The objective of this thesis is to investigate the performance of the orthogonal frequency division multiplexing (OFDM) based IEEE 802.11a wireless local area network (WLAN) standard receiver, when the signal is transmitted over a frequency selective, slow fading Nakagami channel in a worst case, pulse-noise jamming environment. The different combinations of modulation type (both binary and non-binary modulation) and convolutional code rate specified by the WLAN standard, are examined. Receiver performance with Viterbi soft decision decoding (SDD) is analyzed for additive white Gaussian noise (AWGN) alone, as well as for AWGN plus pulse-noise jamming (PNJ). The performance of the IEEE 802.11a WLAN standard receiver is examined both for the scenario where perfect side information is assumed (optimum receiver) and when it is not (sub-optimum receiver). For the sub-optimum receiver scenario, the receiver performance is examined both when noise-normalization is utilized and when only linear combining is utilized. The analysis indicates that the receiver performance is severely affected by the pulse-noise jamming environment for the linear combining scenario; however, the sub-optimum receiver performance is significantly improved when noise-normalization is implemented.

KEYWORDS: IEEE 802.11a WLAN Standard, Nakagami Fading Channel, OFDM, Soft Decision Decoding, Pulse-noise Jamming, Perfect Side Information, Noise-normalization

DESIGN AND IMPLEMENTATION OF A DSP-BASED CONTROL INTERFACE UNIT
Andreas Kavousanos-Kavousanakis-Lieutenant Junior Grade, Hellenic Navy
B.S., Hellenic Naval Academy, 1997
Master of Science in Electrical Engineering-March 2004
Master of Science in Systems Engineering-March 2004
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

In this thesis, the development of a human-body motion tracking system constructed with the use of commercial off-the-shelf (COTS) components is presented. The main component of the system investigated in this thesis is the Control Interface Unit (CIU). The CIU is a component designed to receive data from the magnetic, angular rate, and gravity (MARG) sensors and prepare them to be transmitted through a wireless configuration. Through this research, it was discovered that the MARG sensors had to be redesigned to overcome an erratum on the Honeywell magnetometer HMC1051Z data sheet. With the redesigned MARG sensors, the testing results showed that the CIU was performing extremely well. The overall motion tracking system is capable of tracking human body limb motions in real time.

ELECTRICAL ENGINEERING

ANALYSIS OF NETWORK MANAGEMENT PROTOCOLS IN OPTICAL NETWORKS
Kok Seng Lim-Civilian, Singapore Ministry of Defense
B.E., Nanyang Technological University-Singapore, 1998
Master of Science in Electrical Engineering-March 2004
Advisor: John C. McEachen, Department of Electrical and Computer Engineering
Second Reader: Randy L. Borchardt, Department of Electrical and Computer Engineering

In this thesis, the scalability issues of Simple Network Management Protocol (SNMP) in optical network management are explored. It is important to understand the effect of varying the number of nodes, the request inter-arrival times, and the polling interval on the performance of SNMP and number of nodes that can be effectively managed. The current study explored the effect of varying these parameters in a controlled test environment using the OPNET simulation package. In addition, traffic analysis was performed on measured SNMP traffic and statistics were developed from the traffic analysis. With this understanding of SNMP traffic, an SNMPv1 model was defined and integrated into an OPNET network model to study the performance of SNMP. The simulation results obtained were useful in providing needed insight into the allowable number of nodes an optical network management system can effectively manage.

KEYWORDS: Network Management Protocols, SNMP, CMIP, SONET, Optical Networks, Data Communication Channels, Scalability Issues, Traffic Analysis, OPNET Simulation

AUTONOMOUS LANDING SYSTEM FOR A UAV
Mariano I. Lizarraga-Lieutenant Junior Grade, Mexican Navy
B.S., Mexican Naval Academy, 1995
Electrical Engineer-March 2004
Master of Science in Electrical Engineering-March 2004
Committee Supervisors: Roberto Cristi, Department of Electrical and Computer Engineering
Isaac Kaminer, Department of Mechanical and Astronautical Engineering
Committee Member: Robert Hutchins, Department of Electrical and Computer Engineering

This thesis is part of an ongoing research project conducted at the Naval Postgraduate School. The goal of the project is to achieve the autonomous shipboard landing of Unmanned Aerial Vehicles (UAV). Two main problems are addressed in this thesis. The first is to effectively establish communication between the UAV’s ground station and the Autonomous Landing Flight Control Computer. The second addresses the design and implementation of an autonomous landing controller using classical control techniques. Device drivers for the sensors and the communications protocol were developed in ANSI C. The overall system was implemented in a PC104 computer, running a real-time operating system developed by The Mathworks, Inc. Computer and hardware in the loop (HIL) simulation, as well as ground test results, show the feasibility of the algorithm proposed here. Flight tests are scheduled to be performed in the near future.

KEYWORDS: Unmanned Aerial Vehicles, UAV, Silver Fox, Autonomous Landing, Shipboard Landing, UAV Control System, Real Time Workshop, xPC Target, Piccolo

SYNCHRONIZATION ANALYSIS AND SIMULATION OF A STANDARD IEEE 802.11G OFDM SIGNAL
Keith D. Lowham-Lieutenant Commander, United States Navy
B.S., California State University-Chico, 1986
Master of Science in Electrical Engineering-March 2004
Advisor: Frank E. Kragh, Department of Electrical and Computer Engineering
Second Reader: R. Clark Robertson, Department of Electrical and Computer Engineering

Synchronization of orthogonal frequency-division multiplexed (OFDM) signals is significantly more difficult than synchronization of a single-carrier system. The recently approved IEEE Standard 802.11g specifies a packet-based OFDM system that provides a basis for the discussion of OFDM synchronization in a packet-based environment. Algorithms that synchronize the receiver carrier demodulation frequency and phase, the data frame, the OFDM symbol timing, and the data symbol timing are discussed and
analyzed in an AWGN channel. System View simulation is used to implement the frame and carrier frequency synchronization algorithms, where the performance of these algorithms is analyzed and they are shown to be useful detection algorithms for standard 802.11g signal reception.

**KEYWORDS:** OFDM, Orthogonal Frequency Division Multiplexing, 802.11, 802.11g, AWGN, PBCC, DSSS, DSSS-OFDM, Synchronization, Carrier Synchronization, Frequency Synchronization, Phase Synchronization, Symbol Synchronization, System View, FFT, IFFT, Cyclic Prefix, Guard Interval, Wireless LAN

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**REED-MULLER CODES IN ERROR CORRECTION IN WIRELESS ADHOC NETWORKS**

Serdar U. Tezeren-Lieutenant Junior Grade, Turkish Navy

B.S., Turkish Naval Academy, 1998

Master of Science in Electrical Engineering-March 2004

Advisors: Murali Tummala, Department of Electrical and Computer Engineering

Roberto Cristi, Department of Electrical and Computer Engineering

The IEEE 802.11a standard uses a coded orthogonal frequency division multiplexing (COFDM) scheme in the 5-GHz band to support data rates up to 54 Mbps. The COFDM was chosen because of its robustness to multipath fading effects. In the standard, convolutional codes are used for error correction. This thesis examines the performance of the COFDM system with variable rate Reed-Muller (RM) error correction codes with a goal to reduce the peak-to-average power ratio (PAPR). Contrary to the expectations, RM codes did not provide expected improvement in PAPR reduction. Peak clipping and Hanning windowing techniques were investigated in order to reduce the PAPR. The results indicate that a tradeoff exists between the PAPR and the bit-error rate (BER) performance. Although peak clipping yielded considerable reduction in PAPR, it required high signal-to-noise ratios. On the other hand, Hanning windowing provided only a small reduction in PAPR with reasonable BER performance.

**KEYWORDS:** COFDM, Reed-Muller Error Correction Codes, Convolutional Codes, PAPR, QPSK, Multipath Fading, Peak Clipping, Hanning Windowing, IEEE 802.11a Standard, Outdoor Wireless Digital Communication Channel, Indoor Channel Characteristics, Delay, Doppler Effect

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**PERFORMANCE ANALYSIS OF THE EFFECT OF PULSED-NOISE INTERFERENCE ON WLAN SIGNALS TRANSMITTED OVER A NAKAGAMI FADING CHANNEL**

Andreas Tsoumanis-Lieutenant Junior Grade, Hellenic Navy

B.S., Hellenic Naval Academy, 1996

Master of Science in Systems Engineering-March 2004

Master of Science in Electrical Engineering-March 2004

Advisors: R. Clark Robertson, Department of Electrical and Computer Engineering

Donald V.Z. Wadsworth, Department of Electrical and Computer Engineering and Space Systems Academic Group

This thesis examines the performance of wireless local area network (WLAN) signals, specifically, the signal of IEEE 802.11a standard. The signal is subject to pulsed-noise jamming, when either the desired signal alone or the desired signal and the jamming signal are subject to Nakagami fading. As expected, the implementation of forward error correction (FEC) coding with soft decision decoding (SDD) and maximum-likelihood detection improves performance as compared to uncoded signals. In addition, the combination of maximum-likelihood detection and error correction coding renders pulsed-noise jamming ineffective as compared to barrage noise jamming. When the jamming signal encounters fading as well, it is assumed that the average jamming power is much greater than the AWGN power. For uncoded signals, a jamming signal that experiences fading actually improves performance when the parameter of the information signal, $m_i$, is less than or equal to one. Surprisingly, for larger values of $m_i$, a jamming signal that experiences fading works in favor of the information signal only for small signal-to-interference ratio (SIR). When SIR is large, performance when the jamming signal experiences fading is worse relative to performance when the jamming signal does not experience fading. For error correction coding with SDD, only continuous jamming is investigated, since it is by far the worst case. Moreover, while a range of
fading conditions for the jamming signal are considered, only Rayleigh fading of the information signal is examined. The coded signal, when the jamming signal experiences severe fading, performs better relative to the case when the jamming signal does not experience fading.

**KEYWORDS:** IEEE 802.11a, WLAN, FEC, SDD, OFDM, BPSK, QPSK, MQAM, AWGN, Nakagami, Soft Decision Decoding, Convolutional Code, Pulsed-noise Jamming, Probability of Bit Error

**AN INVESTIGATION OF WIRELESS SOLUTIONS FOR THE “LAST MILE”**
Antonios K. Varelas-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1990
Master of Science in Computer Science-March 2004
Master of Science in Electrical Engineering-March 2004
Advisors: Gilbert M. Lundy, Department of Computer Science
Roberto Cristi, Department of Electrical and Computer Engineering

The need for broadband network access is experiencing rapid growth, but what is currently available is not sufficient. Copper-based technologies cannot address the requirements of today’s bandwidth-intensive Internet applications. End-users in the “last mile” demand access speeds equivalent to those supported by fiber optics backbone networks, although the cost and time associated with its installation are prohibitive factors for bringing fiber to every home and business. This results in the well-known “last mile access problem,” which prevents the Internet from reaching its full potential and has paved the way for the development of many innovative technologies. Driven by demands for more bandwidth, wireless broadband technologies have been proposed.

This thesis provides an investigation of two candidates to address the lack of adequate bandwidth in the “last mile,” Free Space Optics (FSO) and the IEEE 802.11 Wireless Local Area Networking (WLAN) standard. FSO uses optical signals to deliver information at extremely high data rates, more quickly and cost-effectively than fiber systems. The IEEE 802.11 standard uses radio technology to transfer data. They both use license-free frequency bands for transmission through the atmosphere. They both are quickly deployable, easily scalable, and cheaper than wired solutions, characteristics able to support applications requiring high bandwidth and a high degree of mobility.

**KEYWORDS:** Broadband Network Access, Last Mile, FSO, Free Space Optics, WLAN, Wireless Local Area Networking, IEEE 802.11, High Bandwidth, Wireless Broadband Technologies, Fiber Optics
MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

ACOUSTIC CYMBAL TRANSDUCERS-DESIGN, HYDROSTATIC PRESSURE COMPENSATION, AND ACOUSTIC PRODUCERS
Kirk E. Jenne-DoD Civilian
B.S., Florida Atlantic University, 1984
Master of Science in Engineering Acoustics-March 2004
Advisors: Thomas R. Howarth, NAVSEA Division Newport
Dehua Huang, NAVSEA Division Newport
Thomas J. Hofler, Department of Physics

Continuing U.S. Navy interest in the development of light-weight, low-volume, broadband, underwater acoustic projectors and receivers is the principal motivation for this research topic. Acoustic cymbal transducers, so named for their geometric similarity to the percussion instruments, are miniature “class V” flextensional transducers that consist of a piezoelectric ceramic drive element bonded to two opposing cymbal-shaped metal shells. Operating as mechanical transformers, the two metal shells convert the naturally large generative force of a piezoelectric ceramic in the radial mode into increased volume displacement at the metal shell surface to obtain usable source levels and sensitivities in a broad frequency range. The magnified displacement makes the acoustic cymbal element a potential alternative to acoustic transduction technologies presently used to generate and receive Navy sonar frequencies. Potential benefits to utilizing this technology are generating or receiving broadband sound, at sonar frequencies in a thin, low volume, conformable package. Applications of this technology have been limited because air-backed acoustic cymbal elements undergo degradation in performance when exposed to elevated hydrostatic pressure (i.e., deep ocean and extreme littoral water applications). This research shows that consistent and reliable acoustic performance can be achieved with cymbal-based transducers at hydrostatic pressures of interest to the Navy.

KEYWORDS: Acoustic Calibration, Underwater Acoustics, Underwater Sound, Transducer, Flextensional, Acoustic Cymbal, Broadband, USRD, APTF, Piezoelectric, Piezoceramic, Array Elements, Hydrostatic Pressure, Pressure Compensation, Sonar
In this thesis, a structure for Multi-National Force (MNF) Information Operations is presented. This thesis and the recommendations made for a Standard Operating Procedure (SOP) are aimed at improving interoperability and Coalition/Combined Task Force (CCTF) operational readiness. The SOP will focus on the spectrum of Information Operations (IO) with regard to Military Operations Other Than War (MOOTW) and Small Scale Contingencies (SSC) during MNF operations. This thesis will seek to identify the existing IO procedures to be utilized during MNF operations. It will identify, structure, and implement a viable Information Operations Cell Annex to support the SOP.

**KEYWORDS:** Multi-National Force Information Operations, Military Operations Other Than War, Multi National Planning and Augmentation Team, Information Operations

### SPEECH RECOGNITION SOFTWARE: AN ALTERNATIVE TO REDUCE SHIP CONTROL MANNING

Robert Kuffel-Lieutenant, United States Navy  
B.A., California State University, 1996  
Master of Science in Information Systems and Operations-March 2004  
Advisors: LCDR Russell Gottfried, USN, Department of Operations Research  
Monique Fargues, Department of Electrical and Computer Engineering

This study identifies factors affecting the performance of commercial-off-the-shelf speech recognition software (SRS) when used for ship control purposes. After a review of research on the feasibility and acceptability of SRS-based ship control, this thesis examines the effects of vocabulary size, conning experience level, male versus female voices, and pre-test training. The controlled experimentation finds that:

- The experience level of a conning officer has no significant impact on SRS performance.
- Female participants experienced more SRS errors than did their male counterparts. However, in this experiment, only a limited number of trials were available to assess a difference.
- SRS with restricted vocabularies performs no better than SRS with large vocabularies.
- Using the software’s “correct as you go” feature may impact software performance. Following the user profile establishment, individual user training on two specific words reduces error rates significantly.

This study concludes that SRS is a viable technology for ship control and merits further testing and evaluation.

**KEYWORDS:** Speech Recognition, Voice Recognition, Ship Maneuvers, Standard Commands, Ship Handling, Commercial-Off-the-Shelf Software, Voice Activated Control System, Manpower Reducing Technology
The United States is embarking on a course of designing and fielding a Ballistic Missile Defense System (BMDS) to protect the U.S. and her citizenry against ballistic missile attacks. The BMDS will need a Command and Control, Battle Management, and Communications (C2BMC) organization/system to support military and national decision makers in times of crisis. The C2BMC must also be able to react quickly once a missile event has occurred. This thesis covers the doctrinal issues associated with merging Theater Missile Defense (TMD) and the National Missile Warning System into one system, how the Unified Command Plan affects missile defense efforts, lessons learned from Desert Storm, and presents alternative chains of command that might allow the BMDS to engage threat missiles in a timely and efficient manner. Preliminary findings indicate that a “flattened” chain of command for missile defense forces seems to be a positive starting point for the initial deployment of the BMDS.

KEYWORDS: Command and Control, Ballistic Missile Defense System, Global Missile Defense, Battle Management
Multi-Agent Architecture for Integrating Remote Databases and Expert Sources with Situational Awareness Tools: Humanitarian Operations Scenario

Cantemir M. Ahciarliu-Lieutenant Colonel, Romanian Air Force
B.S., Military Technical Academy-Bucharest, 1983
Master of Science in Information Technology Management-March 2004
Advisors: Alex Bordetsky, Department of Information Sciences
Glenn Cook, Department of Information Sciences

Complex Humanitarian Emergencies are usually military-conducted activities where participants must be able to react to a very dynamic and unfriendly environment. National and international participating forces require cooperation and coordination between civilian and military entities. The continuous need to share huge amounts of information requires a technological framework to allow legacy and new hardware and software interconnection, rapid network installation, and flexible bandwidth availability. To improve the speed and quality of the decision making, a scientific approach must be applied to the process. Maximizing both the effectiveness and efficiency in decision making can be accomplished by developing decision support systems capable of providing access to existing databases and expert systems. Databases usually contain raw information available for retrieval and processing according to the needs of the decision makers. Expert systems embed human expertise and allow the propagation of scarce expert resources throughout an organization to increase the consistency and quality of the decisions. Sharing access to these types of information within a Complex Humanitarian Emergency environment provides for better situational awareness and improves the decision making process. This thesis will gather and combine the information from different sources and will suggest a model for integrating remote databases and expert sources with situational awareness tools.

Keywords: Complex Humanitarian Emergencies, Peer-to-Peer Collaborative Software, Decision making, Databases, Situational Awareness Tools, Agents, Web-enabled Databases

Design and Development of a Web-Based DoD PKI Common Access Card (CAC) Instruction Tool
Vasileios Athanasopoulos-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1990
Master of Science in Computer Science-March 2004
Master of Science in Information Technology Management-March 2004
Advisors: Cynthia Irvine, Department of Computer Science
J.D. Fulp, Department of Computer Science
Second Reader: Glenn Cook, Department of Information Sciences

Public-Key Cryptography and the infrastructure that has been designed to successfully implement it: Public Key Infrastructure (PKI) is a very promising computer security technology. As a significant enhancement to this infrastructure, the DoD is now issuing smart card tokens, in the form of the Common Access Card (CAC), to its service members. This card is a relatively complex cryptographic device that contains its user’s private keys, digital certificates, and other personal/administrative information. These cards are issued to service personnel with little or no training regarding what they are or how they function. Such an omission detracts from the infrastructure’s overall security. This thesis presents an introductory-level description of public key cryptography and its supporting infrastructure (PKI). The thesis then goes on to develop a web-based training tool that could provide all DoD CAC holders with the rudimentary knowledge of how their CAC fits into the broader infrastructure. The training tool will require no
instructor, and will present a validation test to each user. DoD commands could utilize this tool to provide basic CAC training to their members.

**KEYWORDS:** Cryptography, Symmetric Cryptography, Asymmetric Cryptography, Public Key, Private Key, Public Key Infrastructure, PKI, DoD PKI, Certificate, Certificate Authority, CA, Local Registration Authority, LRA, Common Access Card, CAC, Web-based Tutorial

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**MONITORING THE PROGRESS OF THE NAVY MARINE CORPS INTRANET (NMCI): IMPLEMENTATION, PERFORMANCE, AND IMPACT**

Dimitrios Dalaklis-Lieutenant, Hellenic Navy  
B.S., Hellenic Naval Academy, 1992  
Master of Science in Information Technology Management-March 2004  
Master of Science in Defense Analysis-March 2004  
Advisor: Glenn Cook, Department of Information Sciences  
Second Reader: Dorothy E. Denning, Department of Defense Analysis

Information superiority is the motivation for the creation of the Global Information Grid (GIG) as the means to provide connectivity between all parts of shore establishments and with all deployed forces at sea and ashore. The Navy Marine Corps Intranet (NMCI) is an Information Technology (IT) services contract to provide secure universal access to integrated voice, video, and data communications; eliminate interoperability problems; and remove network impediments to improve productivity and speed of command to the shore-based components of the Navy and Marine Corps.  

The NMCI contract is the procurement of IT services based on a commercial model of Service Level Agreements (SLAs). Under this model, the emphasis is placed on the verification, validation, and monitoring of the end-user services and not on the underlying infrastructure of systems.  

This research explores the current implementing effort of NMCI and analyzes the way this common network capability is tested and monitored. This thesis will provide a single source of information for managers seeking to quickly understand the impact of NMCI as an enterprise level asset. Security policies related to the project are examined and recommendations to improve this new IT initiative are made.

**KEYWORDS:** Navy Marine Corps Intranet, NMCI, Information Assurance, FORCEnet, IT Services

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**THE FEASIBILITY STUDY OF IMPLEMENTING A FIBER OPTIC LOCAL AREA NETWORK IN THE SOFTWARE METRICS LABORATORY IN INGERSOLL 158**  
Chai Chuan Ee-Major, Republic of Singapore Air Force  
B.Eng, Nanyang Technological University-Singapore, 1994  
Master of Science in Information Technology Management-March 2004  
Advisor: Norman F. Schneidewind, Department of Information Sciences  
Second Reader: Douglas E. Brinkley, Graduate School of Business and Public Policy

This thesis conducts a feasibility study of implementing a Fiber Optic Local Area Network in the Software Metrics Laboratory in Ingersoll Hall, Room 158. Optical fiber has been the preferred cabling technology for certain building and campus network LAN backbones. Until recently, the use of fiber as a cabling medium to the desktop has been confined to special environments that require the unique properties of optical fiber, such as noise immunity, security, distance, high bandwidth demands (CAD/CAM, video conferencing), and immunity to electrical interference. However, choosing to use optical fiber over other cabling options in a network may present significant advantages in the network’s inherent ability to handle data at higher speeds. Decreasing costs of optical fiber components compared to the increasing electronic costs of carrying Gigabit Ethernet over Cat 5 or Cat 5E UTP copper cabling has also accelerated the migration to optical fiber LAN.

**KEYWORDS:** Local Area Network, LAN, Fiber Optic, Gigabit Ethernet, Network Interface Card, Cabling, Copper, Cat 5
INFORMATION TECHNOLOGY MANAGEMENT

TRANSFORMING FLEET NETWORK OPERATIONS WITH COLLABORATIVE DECISION SUPPORT AND AUGMENTED REALITY TECHNOLOGIES
John J. Fay-Lieutenant, United States Naval Reserve
B.A., University of Maine, 1996
Master of Science in Information Technology Management-March 2004
Advisor: Alex Bordetsky, Department of Information Sciences
Second Reader: Gurminder Singh, Department of Computer Science

Current network administrators use network management software to monitor and control elements within a network. This is largely a manual process since managers must interrogate devices individually and evaluate performance statistics manually. The systems provide multiple views on network data but lack capabilities that allow operators to visualize network performance. Since personnel are required to identify problems, interpret potential solutions, and decide on appropriate corrective measures without automatic assistance, maintaining and solving problems for a network can be time-consuming and complex, significantly reducing network efficiency. Since FORCEnet is a heterogeneous concept that combines various C4I networks, sensors, weapon systems, and platforms, a new model must be developed for network operations. This paper researches an improved model for fleet network operations management for distributed sea-based forces using existing technologies. Combining a collaborative tool, Decision Support System (DSS), and Augmented Reality (AR) imagery transforms Naval information network management from a “minimum threshold” to an “operations fusion” perspective. Little is known about AR technologies, but the potential exists for virtual network operations centers that can remotely direct networks for sea and shore assets through collaborative efforts. The product of this paper will serve as a baseline for network operations in the network centric environment.

KEYWORDS: Network Operations, Network Management, Collaboration, Augmented Reality, FORCEnet, Decision Support System

HIGH SPEED NETWORK ACCESS TO THE LAST-MILE USING FIXED BROADBAND WIRELESS
Nikolaos Fougias-Lieutenant Junior Grade, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Master of Science in Information Technology Management-March 2004
Master of Science in Computer Science-March 2004
Advisors: Gilbert M. Lundy, Department of Computer Science
Thomas Houzel, Department of Information Sciences

Despite the increase in the demand for high speed Internet services, the last-mile solutions currently available are either too expensive to attract the majority of the population or not available in low density populated areas. This thesis examines Fixed Broadband Wireless (FBW) as an alternative technology to the current last-mile solutions. The analysis shows that the Local Multipoint Distribution System (LMDS) and the Multichannel Multipoint Distribution Service (MMDS) are the most promising emerging FBW technologies and that they are able, by utilizing microwave radio as their fundamental transport medium and using high modulation schemes, to provide digital two-way voice, data, video, and Internet services. This thesis shows that both technologies are constrained by free space loss and line-of-sight impairments, with rain absorption being the most significant cause of attenuation in the case of LMDS, while vegetation and multipath fading play a significant role mostly in the case of MMDS. Additionally, it is shown that there is a positive association between the data rate achieved and the level of influence due to Additive White Gaussian Noise (AWGN). Based on the analysis and using coverage areas, total capacity, achieved data rates, weather and line-of-sight limitations, and cost as the most important criteria, it is concluded that LMDS is a preferable solution for enterprise end-users in densely populated urban areas outside the reach of fiber networks, while MMDS targets residential end-users in rural or suburban areas that are not able to receive service through high-speed wireline connections.

KEYWORDS: LMDS, MMDS, OFDM, Line-of-Sight, Fresnel Zones, Additive White Gaussian Noise, Bit Error Rate
ADAPTIVE MANAGEMENT OF EMERGING BATTLEFIELD NETWORK
Dimitrios P. Fountoukidis-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1989
Master of Science in Information Technology Management-March 2004
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Alex Bordetsky, Department of Information Sciences
John Hiles, Department of Computer Science

The management of the battlefield network takes place in a Network Operations Center (NOC). The manager, based on the importance of the managed network, is sometimes required to be present all the time within the physical installations of the NOC. The decisions regard a wide spectrum of network configurations, fault detection and repair, and network performance improvement. Especially in the case of the battlefield network operations, these decisions are sometimes so important that they can be characterized as critical to the success of the whole military operation. Most of the time, the response time is so restricted that it exceeds the mean physical human response limits. An automated response that also carries the characteristics of human intelligence is needed to overcome the restrictions the human nature of an administrator imposes.

The research will establish the proper computer network management architecture for an adaptive network. This architecture will enhance the capabilities of network management in terms of cost and efficiency.

KEYWORDS: Adaptive Network, SNMP, Mobile Agents, Artificial Intelligence, Collaborative Agents, MANTRIP Project

CONFIGURATION MANAGEMENT EVALUATION GUIDANCE FOR HIGH ROBUSTNESS SYSTEMS
Michael E. Gross-Lieutenant, United States Navy
B.S., University of Oklahoma, 1994
Master of Science in Information Technology Management-March 2004
Advisors: Cynthia Irvine, Department of Computer Science
Tim Levin, Department of Computer Science
Second Reader: Nelson Irvine, Department of Information Sciences

Configuration Management (CM) plays a vital role in the development of trusted computing systems. The Common Criteria (CC) provides a framework for performing Information Technology (IT) security evaluations of these systems, and further emphasizes CM’s role in the development and evaluation process by specifying a minimum set of CM qualities for each Evaluated Assurance Level (EAL). As an evaluation guide, the Common Methodology for Information Technology Security Evaluation, Part 2: Evaluation Methodology (CEM), recommends a set of minimum CM guidelines which can be used by evaluators in the performance of a CM evaluation at the lower Evaluated Assurance Levels. Evaluators and developers will quickly note the CEM’s lack of recommended CM guidelines at the higher assurance levels.

Thorough study of the listed references supports the hypothesis for this work: Configuration Management guidelines are useful in the evaluation of trusted computing systems. As an assurance mechanism, complete CM guidance helps users of high assurance products obtain a degree of confidence that the system security requirements operate as intended and do not contain clandestine code. Complete CM guidance provides evaluators with a “completed assurance scale” and ensures only authorized changes were made to the Target of Evaluation (TOE) during development.

NETWORK CENTRIC WARFARE: A COMMAND AND CONTROL PERSPECTIVE
Soon Chia Lim-Lieutenant Colonel, Republic of Singapore Air Force
B.E., Victoria University of Manchester, 1990
Master of Science in Information Technology Management-March 2004
Advisor: Dan C. Boger, Department of Information Sciences
Second Reader: William G. Kemple, Department of Information Sciences

This paper seeks to analyze the command and control issues arising from the advent of Network Centric Warfare (NCW). It aims to contribute to a practical understanding of the concept and implementation approach for NCW by attempting to provide an analytical framework for the military decision-maker and the various options/models and considerations across the spectrum of NCW issues.

While information superiority is not a new concept, the blazing speed of advancement in information technologies has brought about profound changes to our lifestyles and in the conduct of modern warfare. These led to the birth of Network Centric Warfare. NCW offers great opportunities to dramatically enhance combat prowess by establishing shared situational awareness, increasing speed of command, improving systems’ lethality and survivability, and enabling greater flexibility through self synchronization. However, these revolutionary changes in NCW do not depend on technology alone. In order to harness the full benefits of NCW, the full span of elements, ranging from organization, doctrine, and operational concepts to training, must co-evolve.

The success of NCW is dependent on aligning the organization’s commitment, resources and efforts, fostering a learning and innovative culture, constructing a seamless, robust and secured infrastructure, and establishing measurement of effectiveness of C2. The journey to NCW is not a linear process, but rather a spiral developmental process based on an architectural framework approach. Continued evolution and efforts are required to shape and deliver the enhanced combat capability as the apex of maturity of the spiraling cone.

KEYWORDS: Network Centric Warfare, NCW, Command and Control, C2

ANALYZING THE FEASIBILITY OF USING SECURE APPLICATION INTEGRATION METHODOLOGY (SAIM) FOR INTEGRATING DEPARTMENT OF THE NAVY ENTERPRISE RESOURCE PLANNING (ERP) APPLICATIONS
Ramon O. Marin-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1992
Master of Science in Information Technology Management-March 2004
Advisor: Glenn Cook, Department of Information Sciences
Douglas E. Brinkley, Graduate School of Business and Public Policy

A thorough examination of the Secure Application Integration Methodology (SAIM) for applicability in the Department of the Navy (DoN) would provide useful information about a beneficial methodology. SAIM is analyzed by accessing its step by step directions, for suitability in the integration of the Enterprise Resource Planning (ERP) projects implemented by the Systems Commands (SYSCOMS).

The Navy Enterprise Convergence Team (NECT) that leads the ERP integration effort could benefit from a sound Enterprise Application Integration methodology. Results do not support SAIM as the sole guiding EAI methodology, however it could have some value to the NECT.

SAIM has three primary benefits which NECT could employ: i) it provides a complete walkthrough of the EAI process, ii) it emphasizes the importance of an Enterprise Architecture, and iii) it provides useful management checklists along with other important considerations.

SAIM also has some significant shortcomings: i) it does not support all the DoN Chief Information Officer requirements, ii) it does not provide Change Management Guidance, iii) it does not take into account the uniqueness of the Navy’s environment, and finally iv) SAIM relies on an Enterprise Architecture, which the Navy does not currently have, as its foundation.

KEYWORDS: Enterprise Resource Planning, Secure Application Integration Methodology, ERP Convergence, Enterprise Application Integration
This thesis addresses the need of Naval Aviation Maintenance to streamline and more effectively manage the process of technical consultation aboard deployed aircraft carriers. The current process involves the physical transportation of an appropriate technician to the carrier to perform required maintenance and/or repairs. In light of the technology currently available, this process becomes obviously obsolete, overly costly, and needlessly time consuming.

By implementing wireless technology in combination with advanced software, allowing the virtual collaboration of parties widely separated by geographical distance, the Navy can establish a “virtual technical presence” onboard aircraft carriers wherever they may be in the world. This thesis will describe how the fusion of wearable computing, augmented reality, intelligent agents coupled with control of agent-based systems (CoABS), and a modern collaborative software application can revolutionize Naval aviation maintenance. The technology is there – it only remains for the Navy to leverage it and take advantage of the significant returns that it will provide.

The implementation of this technology will allow maintainers onboard deployed aircraft carriers to consult in an augmented virtual environment with technical assets on the shore. These shore-based assets will then be able to “walk” deployed personnel through complicated repair procedures in a matter of minutes or hours, as opposed to the previous need to wait for days for the technician to arrive.

This is a bold and innovative new concept that will allow commands at sea to increase their levels of combat readiness and allow them the ability to respond to ever changing mission needs. Turn around times for the repair of critical parts and assemblies will be reduced and readiness levels elevated. The ultimate goal of any command is mission accomplishment. This system will aid commands in achieving that all important goal.

KEYWORDS: Wearable Computing, Augmented Reality, Collaborative Technology, Naval Aviation Maintenance, Intelligent Agents, Control of Agent Based Systems

All nations face increasing tension between exploiting Computer Network Operations (CNO) in the military sphere and protecting the global information grid. The United States is moving apace to develop doctrines and capabilities that will allow them to exploit cyberspace for military advantage. Within the broad rubric of Information Operations, there is increasing effort devoted to integrating CNO into routine military planning. At the same time, many nations are becoming increasingly concerned about the dependency of their militaries, governments, economies, and societies on the networked information systems that are emerging as the central nervous systems of post-industrial society. The desire of the armed forces to exploit and use CNO to their advantage is the central argument for this developed concept. This new weapons platform, or CNO, can be clearly identified so that the leaders will have an understanding of terms, limitations, and capabilities of cyber operations. A methodology incorporating doctrine can be created to identify the Rules of Engagement (ROE) as well as the CNO components. The CNO area of operations and area of interest reach far beyond the typical battle space. The battle space has evolved and has penetrated every element of military operations that utilize computers and networks.
By autumn 2000, NPS wanted to fundamentally update its unique but dated fifty-year-old business of educating 4,000 resident and non-resident military students. This thesis focused on implementing disruptive, compelling change by inexpensively and rapidly kick-starting information flow via website redesign.

The first goal would make the public website more productive. The second goal marketed the school’s new vision and subsequent re-organization. The third goal, and perhaps the most powerful motive, would help the school begin shifting its bureaucratic culture to one of innovation and learning in a relatively short time frame, with no additional funding, and with relatively minimal resistance. Action research will serve as the template to determine how successfully the three goals of productivity, marketing, and culture were achieved.

**KEYWORDS:** Innovation, Organization, Organizational Transformation, Cultivate, Productivity, Marketing, Culture, External Website, [www.nps.navy.mil](http://www.nps.navy.mil), Organizational Development, Talent, Leadership, Technology, WWW
The main purpose of this study was to examine the effect of the Summer Training Program (STP) on vocational development of midshipmen at the United States Naval Academy. To test this effect, a sample of 615 first-class midshipmen and 615 second-class midshipmen from the classes of 2002-2004 completed a survey regarding their experiences on summer cruise. Survey answers were grouped into several factors derived from a review of the literature in vocational psychology. The relationship between these factors and their final warfare community preferences were analyzed using several cross-tabulations, univariate tests, and multivariate models.

Cross-tabulations showed that only 25% of midshipmen change their warfare community preference during the last two years at the Academy. Independent Pearson Correlation ($r$) showed the effect of each of the different factors on warfare community selection. Of the different variables identified: gender, academic major, running-mate qualification/experience, and ship morale were found to have an impact on the desire to select surface warfare at the conclusion of the summer training experience. The multivariate models (logit) verified that the above variables were significant in determining the choice of warfare community and also showed that observed ship morale was the dominant factor above all others in helping to form career interests.

**KEYWORDS:** Summer Training Program, United States Naval Academy, Vocational Psychology, Self-efficacy, Vocational Development, Warfare Community Selection, Surface Warfare, Air Warfare, Submarine Warfare
THE CONSOLIDATION OF ADMINISTRATIVE FUNCTIONS FOR U.S. MARINE FORCES, PACIFIC

Patrick E. Allen-Captain, United States Marine Corps
B.A., University of Mississippi, 1996
Master of Science in Management-March 2004
Advisors: LtCol Susan G. Dooley, USMC, Defense Resources Management Institute
Samuel E. Buttrey, Department of Operations Research

Marine Administrative Message 441/99 directed that Marine Corps administration be consolidated above the battalion level. Marine Administrative Message 027/04 directed that over 1,300 Marine Corps billets be civilianized.

To embrace both of these directives, this thesis has attempted to describe the consolidation of administrative functions within U.S. Marine Forces, Pacific, to the installation level and the civilianization of all non-inherently-governmental structure. The active duty manpower savings would total 120 marines while actually decreasing the cost of the activity of conducting administration for Oahu-based units by $1.3 million. It is necessary to consolidate all 120 billets to be civilianized. If consolidation does not occur, then the Marine Corps administrator billets within the deploying units will remain inherently governmental and unavailable for conversion. It is only through centralizing non-military tasks that civilianization can be optimized.

A deployable cell concept is described to support the 14 deploying units from Oahu. This concept will have to dovetail with future technologies to successfully deploy over-the-horizon administrative support.

KEYWORDS: Consolidated Administration, Civilianization of Military Manpower

THE VALUE OF THE 1999 USMC RETENTION SURVEY IN EXPLAINING THE FACTORS THAT INFLUENCE MARINES’ SUBSEQUENT STAY/LEASE BEHAVIOR

Yasar Cakmak-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1996
Master of Science in Management-March 2004
Advisors: Susan Page Hocevar, Graduate School of Business and Public Policy
Kathryn M. Kocher, Graduate School of Business and Public Policy

This study examines the factors that influence active duty Marines in their retention decisions. Data from the 1999 U.S. Marine Corps retention survey are matched with actual retention data from personnel files and limited to Marines eligible to make a stay/leave decision within 24 months of the survey. Four subgroups are defined: enlisted first-term males, enlisted first-term females, enlisted career males, and officer junior grade males.

Bivariate analysis of explanatory control variables (personal characteristics and military background) and focus variables (responses to questionnaire items about civilian employment opportunities and satisfaction with aspects of military life) indicates significant associations with retention. Factor analysis is used to create seven satisfaction dimensions from the satisfaction variables. Multivariate logistic regression model results show that all the satisfaction dimensions are significant for the enlisted first term male model. Satisfaction dimensions for pay and benefits, health benefits, work equity, current job characteristics, and future career opportunities are significant in one or more of the remaining models. Searching for a civilian job is significant in all models and perceptions of civilian job opportunities are significant in most. Among control variables, the interaction of marital status, dependents, and working spouse has a significant effect on retention for first term enlisted males, the only group large enough to test.
THE GLASS CEILING EFFECT AND ITS IMPACT ON MID-LEVEL FEMALE MILITARY OFFICER CAREER PROGRESSION
Adrienne F. Evertson-Major, United States Marine Corps
B.A., Norwich University, 1990
Master of Science in Management-March 2004
Amy M. Nesbitt-Captain, United States Air Force
B.S., United States Air Force Academy, 1999
Master of Business Administration-March 2004
Advisors: Gail F. Thomas, Graduate School of Business and Public Policy
Leslie E. Sekerka, Graduate School of Business and Public Policy

Women in the military are considered a minority population. Recent numbers reflect a 16% representation by women of the total Armed Forces population, with the Air Force displaying the largest proportion (17%), while the Marine Corps has the smallest proportion (6%). Multiple Defense organizations have expressed concern about the progression of women officers into senior leadership positions and the barriers they face to their continued success in the military.

This thesis explores the officer career path experienced by women officers progressing through the ranks, primarily during the mid-level grades of Captain (O-3) through Lieutenant Colonel (O-5). It specifically examines women in the United States Marine Corps and Air Force because these two branches of service currently maintain the smallest and largest proportion of women, respectively. Researchers examined the demographic composition of the individual service communities and conducted personal interviews with mid-level (O-3 to O-5) and senior (O-6 and above) officers to investigate any commonalities paralleling the military to the civilian sector. Specifically, this inquiry looks at the “glass ceiling” effect and any strong similarities or differences that may exist between the Marine Corps and the Air Force. Resulting information is expected to reveal a better understanding of military women’s career progression and factors that may exist in today’s Armed Services and influence their decision to continue or separate from the military.

KEYWORDS: Glass Ceiling, Career Progression, Women in the Military

CONTINUATION RATES FOR STAFF NONCOMMISSIONED OFFICERS, IN A NON-OBLIGOR STATUS, SERVING IN THE SELECTED MARINE CORPS RESERVE
Reginald L. Hairston-Major, United States Marine Corps
B.S., James Madison University, 1988
Master of Science in Management-March 2004
Advisor: Kathryn M. Kocher, Graduate School of Business and Public Policy
Second Reader: Samuel E. Buttrey, Department of Operations Research

This thesis examines factors that influence the retention of male Staff Noncommissioned Officers (SNCOs) in the Selected Marine Corps Reserve who have completed their six-year initial military obligation. Data were extracted from the Reserve Components Common Personnel Data System. Logit regression was used to measure the influence of various demographic and military variables on retention to 15 years and retention to 18 years. Models were developed to assess the probability of a Marine SNCO staying to 15 years of service and 18 years of service, respectively. The thesis identified four significant factors that influence retention in the 15 year model, and five significant factors in the 18 year model. In both models, single Marines with no dependents are more likely to separate from the Selected Reserves than married Marines with dependents. Staff Sergeants (E6) are more likely to separate from the Selected Reserves than Gunnery Sergeants (E7), while Master Sergeants/First Sergeants and Master Gunnery Sergeants/Sergeants Major are more likely to reach the 15 and 18 year milestones than E7s. Serving in a combat support occupational field proved to be a significant predictor in the 18 year model, but it was not useful in the 15 year model.

KEYWORDS: Marine Corps, Retention, Enlisted Retention, Officer Retention, Survey, Manpower Policy, Manpower, Personnel Attitudes, Perceptions, Satisfaction with Life in the Military
MANAGEMENT

KEYWORDS: Retention, Attrition

SURVIVAL ANALYSIS AND ACCESSION OPTIMIZATION OF PRIOR ENLISTED UNITED STATES MARINE CORPS OFFICERS
Phillip J. Hoglin-Major, Australian Army
B.S., University of New South Wales, 1993
Master of Science in Management-March 2004
Advisors: Kathryn M. Kocher, Graduate School of Business and Public Policy
Samuel E. Buttrey, Department of Operations Research

The purpose of this thesis is first, to analyze the determinants on the survival of United States Marine Corps Officers, and second, to develop the methodology to optimize the accessions of prior and non-prior enlisted officers. Using data from the Marine Corps Officer Accession Career file (MCCOAC), the Cox Proportional Hazards Model is used to estimate the effects of officer characteristics on their survival as a commissioned officer in the USMC. A Markov model for career transition is combined with fiscal data to determine the optimum number of prior and non-prior enlisted officers under the constraints of force structure and budget.

The findings indicate that prior enlisted officers have a better survival rate than their non-prior enlisted counterparts. Additionally, officers who are married, commissioned through MECEP, graduate in the top third of their TBS class, and are assigned to a combat support MOS have a better survival rate than officers who are unmarried, commissioned through USNA, graduate in the middle third of their TBS class, and are assigned to either combat or a combat service support MOS. The findings also indicate that the optimum number of prior enlisted officer accessions may be considerably lower than recent trends and may differ across MOS. Based on the findings, it is recommended that prior enlisted officer accession figures be reviewed.

KEYWORDS: Attrition, Accession, Commissioning Sources, Cox Regression, Enlistment, Manpower, Markov, Officer Retention, Optimization, Parametric, Personnel Attrition, Prior-enlisted Officers, Quality of Life, QOL, Recruiting, Retention, Requirements Determination, Semi-parametric, Survival Analysis, Transitional Models, Proportional Hazards

SENSITIVITY ANALYSIS FOR AN ASSIGNMENT INCENTIVE PAY IN THE U.S. NAVY ENLISTED PERSONNEL ASSIGNMENT PROCESS IN A SIMULATION ENVIRONMENT
Karsten Logemann-Commander, German Navy
M.B.A., German Armed Forces University Hamburg, 1990
Master of Science in Management-March 2004
Advisor: William R. Gates, Graduate School of Business and Public Policy
Second Reader: CDR William D. Hatch, USN, Graduate School of Business and Public Policy

The enlisted personnel assignment process is a major part of the United States Navy’s Personnel Distribution system. It ensures warfighters and supporting activities receive the right sailor with the right training to the right billet at the right time (R^3) and is a critical element in meeting the challenges of Seapower 21 and Global CONOPS. The means to attain these optimal goals need to be customer-centered and should optimize both the Navy’s needs and the sailor’s interests. Recent studies and a detailing pilot in 2002 used a web-based marketplace with two-sided matching mechanisms to accomplish this vision. This research examines the introduction of an Assignment Incentive Pay (AIP) as part of the U.S. Navy’s enlisted personnel assignment process in a simulation environment. It uses a previously developed simulation tool, including the Deferred Acceptance (DA) and the Linear Programming (LP) matching algorithm, to simulate the assignment process.

The results of the sensitivity analysis suggested that the Navy should mainly emphasize sailor quality rather than saving AIP funds in order to maximize utility and the possible matches. Also, when adopting such an introduction policy, the percentage of unstable matches under the LP as the matching algorithm was reduced.
**THE DETERRENCE EFFECT OF THE IMPLEMENTATION OF THE DEPARTMENT OF DEFENSE’S DRUG PREVENTION POLICY AMONG MILITARY PERSONNEL**

Ananias Meletiadis-Lieutenant Commander, Hellenic Navy  
B.A., Hellenic Naval Academy, 1989  
Master of Science in Management-March 2004  
Advisor: Stephen L. Mehay, Graduate School of Business and Public Policy  
Second Reader: Elda Pema, Graduate School of Business and Public Policy

This thesis examines the magnitude of the deterrence effect associated with the implementation of the “zero tolerance” policy in the U.S. military in the early 1980s. The estimation of the deterrence effect is based on the estimation of linear probability models (LPM). A difference-in-difference estimator is obtained by comparing pre- and post-policy differences in drug use rates in the military and civilian sectors.

This thesis uses data on drug participation drawn from the National Household Survey of Drug Abuse and the DoD Worldwide Health Survey. One study investigates the deterrence effect for the military as a whole, for each branch, for various age groups, and two different measures of drug participation.

The results show that a significant deterrence effect appears to have been associated with the implementation of the “zero tolerance” and drug testing policy, especially for the past year drug participation rates. Additionally, there is evidence that individuals above 25 years old who are more educated and married have smaller drug participation rates than the rest of the population.

**KEYWORDS:** Deterrence Effect, Zero Tolerance, Difference-in-Difference Estimators, Prevention Policy

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**A QUALITATIVE ANALYSIS OF THE EFFECT OF THE REMEDIAL PHYSICAL CONDITIONING PROGRAM ON RETENTION AND ATTRITION AS IT RELATES TO SEMPER FIT AND THE P2T2 ACCOUNT**

Joseph L. Newcomb, III-Captain, United States Marine Corps  
B.S., Southern Illinois University, 1995  
Master of Science in Management-March 2004  
Advisor: LCDR Kathleen Kujawa, USN, Naval Health and Research Center  
Second Reader: CDR William D. Hatch, USN, Graduate School of Business and Public Policy

As the Department of the Navy and Marine Corps looks for efficiencies in Force End Strength Management and improvements to Sailor and Marine quality of life, Semper Fit may provide some answers. This research specifically focuses on the Marine Corps Body Composition Program (BCP) and Remedial Physical Conditioning Program (RPCP). The purpose is to qualitatively analyze a program for Marines who are overweight or on remedial Physical Training (PT) programs, focusing on the feasibility of Marines obtaining professional assistance from Semper Fit. The scope of this research evaluates existing programs and analyzes their beneficial affects in improving retention and attrition of RPCP Marines. The research shows that Semper Fit professionals would provide a consistent program, through mandatory training in health, nutrition, and fitness, to those Marines considered overweight and poorly conditioned by USMC standards. Semper Fit would directly support unit commanders with classes in nutrition, health, and fitness tailored for each RPCP Marine. Furthermore, this study validates the newly established Department of Defense Physical Readiness Test Standards recently adapted by the Department of the Navy as highly accurate. This study recommends the Marine Corps further expand the role of Semper Fit in support of the Marine and unit commander.

**KEYWORDS:** Body Composition Methods, Marine Corps Body Composition Program and Remedial Physical Conditioning Program, Military Health and Fitness Programs, Psychological Responses of Marines on the Weight Control Program, Semper Fit, Physical Training, Research, PFT, PRT, P2T2
The authors examine the history of immigrant military service in the United States, explore the motivations of non-citizen enlistees, and analyze the military performance of non-citizens relative to that of citizen enlistees. Information sources include a comprehensive review of literature, focused interviews with a small sample of non-citizen enlistees, and cohort data files of enlisted personnel who entered the military from 1990 through 1998. The history of non-citizen service corresponds roughly to the nation’s history of immigration and naturalization policy, with military service having offered immigrants economic benefits, as well as a path toward assimilation. Service by non-citizens has also provided the country a way to meet its military manpower needs. The results of statistical analyses suggest non-citizens have lower predicted rates of first-term attrition, and higher estimated rates of retention beyond the first term and promotion to E-4. The authors conclude that non-citizens provide a valuable source of manpower, and fulfill important and influential roles for the next generation. Thus, it may be worthwhile to provide non-citizens more information about enlistment opportunities and to implement unique reenlistment incentives, including expedited green-card status for family members. Future research should examine specific ethnic categories of interest within the population of non-citizens.

**KEYWORDS:** Non-citizens, Immigrants, Latinos, Mexicans, Asian/Pacific Islanders, Filipinos, Enlistees, First-Term Enlistees, Attrition, Retention, Promotion
Motivated by the sizable ledger of ships sent to the ocean floor without ever sustaining a direct hit during World War II, a heightened interest in ship shock survivability spread throughout the Naval Engineering community. As a result, over the last fifty years, Live Fire Test and Evaluations, otherwise known as ship shock trials, have been conducted in order to determine the seaworthiness of each new class of ship commissioned in the U.S. Fleet. While beneficial in determining the overall survivability of a ship and its mission essential equipment in a severe shock environment, these Navy-mandated tests pose serious danger to the crew, ship, and environment.

As an alternative to these labor intensive, costly, and time consuming at-sea tests, recent advances in computer processing power have made it possible to employ finite element methods involving complex geometries in the modeling and simulation of shock response for the ship and surrounding fluid. This thesis examines the accuracy of shock simulation predictions as compared to the ship shock trials conducted on USS WINSTON S. CHURCHILL (DDG-81). An investigation of the effects of sensor location, damping, and shot geometry is presented as validation of the Naval Postgraduate School modeling and simulation methodology.


This thesis developed the sample fabrication and experimental design for studying interfacial creep at thin film/silicon interfaces. The specific interface of study was the crystalline interface created by positive vapor deposition (PVD) of a metallic thin film on a very smooth silicon substrate. Emphasis was placed on development and refinement of the fabrication techniques necessary to produce test samples that provide valid reproduction of the interfacial stress state in isolation from other stresses inherent in the complete device. Test sample fabrication utilized traditional laboratory methods combined with leading edge methodology in two fabrication steps: namely diffusion bonding of a silicon substrate/PVD aluminum thin film/silicon substrate composite structure and micro-machining silicon through the use of a Tetra Methyl Ammonium Hydroxide (TMAH) based etchant. In conjunction with the sample development, a test platform was designed, fabricated, assembled, and aligned to provide for isolated parametric characterization of the proposed interfacial creep model. The results of this characterization are anticipated to be of significant utility in improving the design for fabrication and reliability of current and next generation microelectronic and microelectro-mechanical devices.
Solder joints provide both electrical and mechanical interconnections between a silicon chip and the packaging substrate in an electronic application. The thermomechanical cycling (TMC) in the solder due to the mismatch of the coefficient of thermal expansion (CTE) between the silicon chip and the substrate causes numerous reliability challenges. The ongoing transition to lead-free solders worldwide and the trend towards larger, hotter-running chips aggravate this situation. Therefore, improved solder joints, with higher resistance to creep and low-cycle fatigue, are necessary for future generations of microelectronics. This study reports on the development of a process to fabricate solder joints with a fine distribution of shape memory alloys (SMA) NiTi particulate. The microstructure and interface zone of the as-reflowed solder-SMA composite has been characterized.
PREDICTION OF TROPICAL CYCLONE FORMATION IN THE WESTERN NORTH PACIFIC
 USING THE NAVY GLOBAL MODEL
 Caroline A. Bower-Captain, United States Air Force
 B.S., Cornell University, 1999
 Master of Science in Meteorology-March 2004
 Advisors: Patrick A. Harr, Department of Meteorology
 Russell L. Elsberry, Department of Meteorology

The Tropical Cyclone Vorticity Tracking Program is used to identify vortices in the western North Pacific from the Navy Operational Global Atmospheric Prediction System (NOGAPS) analyses and forecasts during May–October 2002 and 2003. Based on the NOGAPS analyses, several parameters are different between the 23 vortices that developed into storms during 2002 according to the Joint Typhoon Warning Center (JTWC) and the 231 vortices that did not develop. After eliminating 127 vortices that did not persist at least 24 hours, this left 104 non-developing cases. For the developing circulations, the average 850-mb relative vorticity value at the first JTWC-warning time was $5.0 \times 10^{-5}$ s$^{-1}$, with an easterly deep layer wind shear of $-1.8$ m s$^{-1}$. The average 850-mb relative vorticity maximum for the non-developing cases was $3.3 \times 10^{-5}$ s$^{-1}$, with a westerly vertical shear of $4.1$ m s$^{-1}$. The NOGAPS model tends to over-forecast relative vorticity prior to formation time for both developers and non-developers. Especially for the 72-hour and 96-hour forecasts, the over-forecasting tendency leads to non-developing vortices meeting the threshold vorticity value of the developing vortices. The tendency for NOGAPS to forecast the non-developing deep layer wind shear to become increasingly easterly with time is considered to be a major factor in these over-forecasts of formation. Some adjustments in the cumulus parameterization heating and moistening plus convective momentum transport may improve these forecasts of tropical cyclone formation.

KEYWORDS: Tropical Meteorology, Tropical Cyclone Genesis, Tropical Cyclone Formation Forecasts
EROSION IN SOUTHERN MONTEREY BAY
Juan R. Conforto Sesto-Lieutenant Commander, Spanish Navy
B.S., Escuela Naval Militar (Spanish Naval Academy), 1989
Master of Science in Meteorology and Physical Oceanography-March 2004
Advisor: Edward B. Thornton, Department of Oceanography
Second Reader: James MacMahan, National Research Council Research Associate

The coastal cliff top line recession has historically been used to calculate erosion along the Southern Monterey Bay. Digital photogrammetry is used in this work to produce Digital Terrain Models (DTM), representing the coastal cliff top line of 1984. This links the historical recession data sets with the light detection and ranging (LIDAR) measurements of 1997 and 1998 and a 2003 cliff top line measured using Kinematic DGPS. Recession time series starting in the 1940’s are produced for several locations. Least square linear fits of the recession data are computed for the periods 1940-84, 1940-98 and 1940-03. At Fort Ord and Sand City the resulting slopes show a persistent erosion trend of ~1 meter/year, unchanged in the last 19 years. The mean sea level (MSL) evolution is studied using historical San Francisco MSL data because of its high correlation with Monterey MSL. Higher MSL during El Niño years, coincident with higher erosion rates, show the correlation between erosion and MSL. In the long term, high-erosion El Niño years combine with normal years averaging to a near constant erosion trend. For Phillips Petroleum and Beach Lab, a significant decrease in the erosion rate is observed after sand mining stopped in Sand City.

Digital photogrammetry provides a high-quality representation of the shoreline topography, offering useful information to the warfighter in terms of detailed beach or landing zone characterizations.

KEYWORDS: Coastal Erosion, Photogrammetry, El Niño, Southern Monterey Bay

FACTORS INFLUENCING THE STRUCTURE OF THE MONTEREY BAY SEA BREEZE
Emily M. Duvall-Lieutenant Junior Grade, United States Naval Reserve
B.A., Bellarmine University, 2000
Master of Science in Meteorology and Physical Oceanography-March 2004
Advisor: Wendell A. Nuss, Department of Meteorology
Second Reader: David S. Brown, Department of Meteorology

The sea breeze is a thermally induced circulation that arises along essentially every coastline. However, the Monterey Bay circulation associated with the sea breeze varies day to day because of the influence of features such as inversions, clouds, synoptic-scale flow, and topography. Understanding the sea breeze is important because it impacts fire weather, air pollution, agriculture, and aviation operations, among other things. Analyses are conducted using a multi-quadric based program to investigate the Monterey Bay sea breeze during 01-31 August 2003. This program incorporates aircraft data, surface observations, and profiler data. Outputs from the analysis program are plotted in VISUAL to characterize the structure of the sea breeze. Factors including inversions, cloud cover, amount of heating, distribution of heating, synoptic-scale flow, and topography are studied to determine their influence on the sea breeze. Six days that best illustrate the factors that influence the structure of the Monterey Bay sea breeze are presented in this thesis. Results show that offshore flow weakened the strength of the sea breeze and decreased the depth, as expected. A cooling trend in surface temperatures at the end of the month also weakened the strength of the sea breezes and decreased the depth. Clouds are present during this period, which influenced the amount of heating, and consequently, the sea breeze response. The presence of a marine layer weakened the thermal gradient that in turn, weakened the sea breeze circulation.
The objective of this thesis is to investigate the forecastability of optical turbulence using the U.S. Navy’s Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS). First, a detailed synoptic study was performed over the Eastern Pacific region for observation periods in October 2001 and March 2002 to focus on mesoscale features affecting Vandenberg AFB. Second, a modified version of COAMPS version 2.0.16 model output was evaluated to ensure reasonable modeling of the mesoscale. Next, temperature and dewpoint temperature vertical profiles of COAMPS, modified with the Turbulent Kinetic Energy (TKE) Method, were initially compared with balloon-launched rawinsondes, then with higher resolution thermosondes. Optical turbulence parameters were then calculated from the data and a comparison between synthetic profiles and thermosonde-derived profiles were qualitatively and quantitatively studied. Then the vertical resolution of the model was increased for selected forecasts to determine the potential for forecast improvement.

**KEYWORDS:** Atmospheric Modeling, COAMPS, Modeling, Numerical Modeling, Optical Turbulence, Optics, TKE Method, TKE-Free Method, Turbulence, Turbulent Kinetic Energy
MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

AUTONOMOUS-AGENT BASED SIMULATION OF ANTI-SUBMARINE WARFARE OPERATIONS WITH THE GOAL OF PROTECTING A HIGH VALUE UNIT
Fahrettin Akbori-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1998
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisor: Chris Darken, Department of Computer Science
Second Reader: Curtis L. Blais, Modeling, Virtual Environments, and Simulation Institute

The Anti-Submarine Warfare (ASW) screen design simulation is a program that provides a model for operations in anti-submarine warfare. The purpose of the program is to aid ASW commanders, allowing them to configure an ASW screen, including the sonar policy, convoy speed, and the number of ships, to gain insight into how these and other factors beyond their control, such as water conditions, impact ASW effectiveness. It is also designed to be used as a training tool for ASW officers. The program is implemented in Java programming language, using the Multi Agent System (MAS) technique. The simulation interface is a Horizontal Display Center (HDC) which is very similar to a MEKO200 class Frigate Combat Information Center's (CIC) HDC. The program uses Extensible Markup Language (XML) files for reading data for program scenarios. The simulation also provides all the output data at the end of run time for analysis purposes. The program user’s goal, and the purpose of the program, is to decrease the number of successful attacks against surface vessels by changing the configuration parameters of the ASW screen to reflect sonar policy, convoy speed, or number of ships in the simulation. Ongoing use of the program can provide data needed to anticipate required operational needs in future ASW situations.

KEYWORDS: Anti-Submarine Warfare, ASW, Anti-Submarine Warfare, ASW, Screen, Multi Agent Systems, Artificial Intelligence, Protection of High Value Unit, HVU, Combat Information Center, CIC, Naval Simulations, Combat Information Center, CIC, Watch Officer, Sonar Detection, Submarine Torpedo Attack, Decision Making, Cognitive Factors

DEVELOPING AN AFTER ACTION REVIEW SYSTEM FOR A 3D INTERACTIVE TRAINING SIMULATION USING XML
Dimitrios E. Filiagos-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Master of Science in Computer Science-March 2004
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Rudolph P. Darken, Department of Computer Science
CDR Joseph A. Sullivan, USN, Department of Computer Science

An important capability that many modern 3D interactive training simulations lack is an After Action Review System (AARS) that helps both the trainer and the trainee conduct an After Action Review (AAR). Although AAR is not a new idea in the 3D simulation field, it is not widely used in training simulations. In real life training, AAR has proven to be one of the most important phases of the training procedure, sometimes taking the form of debriefing, or in other cases, by conducting a deeper analysis and discussion of the facts. In order to conduct an AAR, a well-designed system must exist to keep track of the conditions and the actions during an exercise, so they can be available for review later. This thesis translates the idea of AAR for real training situations to the 3D interactive simulation domain and also develops an After Action Review System (AARS) using XML technology for capture, analysis, and
interactive playback of an entire simulation training session. Users can change the point of view to any desired position and direction, something that is impossible in video streaming playbacks.

KEYWORDS: After Action Review, After Action Discussion, Capture, Playback, Platform, Platform Path, HLA, Federation

ADAPTIVE MANAGEMENT OF EMERGING BATTLEFIELD NETWORK
Dimitrios P. Fountoukidis-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1989
Master of Science in Information Technology Management-March 2004
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Alex Bordetsky, Department of Information Sciences
John Hiles, Department of Computer Science

The management of the battlefield network takes place in a Network Operations Center (NOC). The manager, based on the importance of the managed network, is sometimes required to be present all the time within the physical installations of the NOC. The decisions regard a wide spectrum of network configurations, fault detection and repair, and network performance improvement. Especially in the case of the battlefield network operations, these decisions are sometimes so important that they can be characterized as critical to the success of the whole military operation. Most of the time, the response time is so restricted that it exceeds the mean physical human response limits. An automated response that also carries the characteristics of human intelligence is needed to overcome the restrictions the human nature of an administrator imposes.

The research will establish the proper computer network management architecture for an adaptive network. This architecture will enhance the capabilities of network management in terms of cost and efficiency.

KEYWORDS: Adaptive Network, SNMP, Mobile Agents, Artificial Intelligence, Collaborative Agents, MANTRIP Project

DISTRIBUTED TEAM COLLABORATION IN A COMPUTER MEDIATED TASK
Amy L. Halin-Lieutenant Commander, United States Navy
B.A., University of Pennsylvania, 1993
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Rudolph P. Darken, Department of Computer Science
Susan G. Hutchins, Department of Information Sciences

Due to the rapid development of technology, many simple tasks can now be automated, leaving more difficult and cognitive tasks such as planning, decision making and design, to teams. Technology also allows these teams to be distributed through time and space. While this is becoming more and more prevalent in the business world, distributed teams also exist in the military where the stresses are much different.

One of the key factors associated with collaboration in military teams is situational awareness. This research used a commercial command and control type video game to investigate the issues of collaboration and situational awareness. The amount of information available to subjects was varied to determine if there was a significant impact upon their level of situational awareness. Situational awareness was measured by the accuracy of maps that the subjects drew.

Results from this research may provide insight into how much information is needed by distributed teams and when they need it. Ideas for future research in this area have also been proposed.

KEYWORDS: Teams, Situational Awareness, Computer Based Environment
The objective of the ongoing MARG project is to animate human motions captured by 15 MARG sensors in a wireless networked virtual environments (NVES). Three avatars were developed previously, but none of them met all the desired requirements. The first one was overly simplistic and did not implement H-Anim standards. The other two were created using laser-scanned data and followed the H-Anim standards, but one had its adjacent joints broken and the other was capable of rotating only one joint. Therefore, we developed the cartoon-type humanoid Andy to meet the needs of the MARG project. The humanoid Andy implements H-Anim standards using built-in X3D humanoid nodes and is capable of controlling all of its 15 joints in NVES.

Another need of the MARG project was a wireless network interface for real-time data streaming. For this purpose, a concurrent client-server program implementing multicasting using Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) was developed. Using WiSER2400.IP serial adapters between the MARG sensors and the server program adds a wireless capability to the project. The server program converts the raw MARG sensor data to quaternions using the Quest algorithm. Multiple clients are supported by the system. Each client program receives the motion data and updates the humanoid Andy.

**KEYWORDS:** VRML, X3D, Java Network, Java, MARG Sensor, Networked Virtual Environments, Virtual Environments, Humanoid, Avatar, Human Animation, Body Tracking, H-Anim, Control Interface Unit, WiSER2400.IP
This thesis explores Benders decomposition for solving interdiction problems on electric power grids, with applications to analyzing the vulnerability of such grids to terrorist attacks. Some existing optimization models and algorithms are refined and extended, and the value of these techniques is demonstrated using standard reliability test networks from IEEE.

Implementation of Benders decomposition optimally solves any problem instance, in theory. However, run times increase as Benders’ cuts are added to the master problem, and this has prompted additional research to increase the decomposition’s efficiency. Empirical speed ups are demonstrated by dropping slack cuts, solving a relaxed master problem in some iterations, and using integer, but not necessarily optimal, master-problem solutions. These mixed strategies drastically reduce computation times. For example, in one test case, the optimality gap and the time that it takes to achieve this gap is reduced from 16% in 75 hours to 5% in 16 minutes.

KEYWORDS: Electric Power Grids, Network Interdiction, Mixed Integer Programming

The minimum-cost procurement and allocation of anti-ship cruise missiles to naval combat ships is modeled as a two-period stochastic integer program. Discrete scenarios in two periods define “demands” for missiles (i.e., targets and number of missiles required to kill those targets), which must be met with sufficiently high probabilities. After the former combat period, ships may replenish their inventories from a depot if desired and if the available depot inventory suffices. A force commander optimizes ship-to-target assignments to meet demands. The basic model solves slowly, so constraints to enforce reasonable operational directives and add valid inequalities are added. These improvements reduce the solution time by 95% for the test case. Instances with up to six ships and five scenarios in each period then solve in less than one hour on a 2 GHz personal computer.

KEYWORDS: Inventory Models, Target Assignment, Integer Programming
OPERATIONS RESEARCH

HOW TO OPTIMIZE JOINT THEATER BALLISTIC MISSILE DEFENSE
Douglas D. Diehl-Lieutenant, United States Navy
B.G.S., University of Missouri, 1997
Master of Science in Operations Research-March 2004
Advisor: Gerald G. Brown, Department of Operations Research
Second Reader: CAPT Jeffery Kline, USN, Department of Operations Research

Many potential adversaries seek, or already have, theater ballistic missiles capable of threatening targets of interest to the United States. The U.S. Missile Defense Agency and armed forces are developing and fielding missile interceptors carried by many different platforms, including ships, aircraft, and ground units. Given some exigent threat, the U.S. must decide where to position defensive platforms and how they should engage potential belligerent missile attacks. To plan such defenses, the Navy uses its Area Air Defense Commander (AADC) system afloat and ashore, the Air Force has its Theater Battle Management Core Systems (TBMCs) used in air operations centers, and the Missile Defense Agency uses the Commander’s Analysis and Planning Simulation (CAPS). AADC uses a server farm to exhaustively enumerate potential enemy launch points, missiles, threatened targets, and interceptor platform positions. TBMCs automates a heuristic cookie-cutter overlay of potential launch fans by defensive interceptor envelopes. Given a complete missile attack plan and a responding defense, CAPS assesses the engagement geometry and resulting coverage against manually prepared attack scenarios and defense designs. Enemy courses of action are expressed as a mathematical optimization to maximize expected damage. It is then shown how to optimize U.S. defensive interceptor pre-positioning to minimize the maximum achievable expected damage. Researchers can evaluate exchanges where each of the defending platform locations and interceptor commitments are hidden from or known in advance by the attacker. Use of a laptop computer can produce a provably optimal defensive plan in minutes.

KEYWORDS: Optimization, Mathematical Programming, Joint Theater Ballistic Missile Defense

ANALYSIS OF SURFACE SHIPS ENGINEERING READINESS AND TRAINING
Brant T. Landreth-Lieutenant, United States Navy
B.S., University of Northern Colorado, 1996
Master of Science in Operations Research-March 2004
Advisor: Samuel E. Buttrey, Department of Operations Research
Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

This thesis analyzes engineering readiness and training onboard United States Navy surface ships. On the west coast, the major contributor to training is the Afloat Training Group, Pacific (ATGPAC). The primary objective is to determine whether the readiness standards provide pertinent insight to the surface force Commander and generate alternatives that may assist in better characterization of force-wide engineering readiness.

The Type Commander has many questions that should be answered. Some of these are addressed with Poisson and binomial models. The results include: first, age of a ship has no association with performance of drills and that the number of discrepancies is associated with the performance of drills; second, drill performance decreased from the first initial assessment (IA) to the second IA; third, on average, the number of material discrepancies decreases from the IA to the underway demonstration (UD) for ships observed over two cycles; fourth, good ships do well on four programs; finally, training is effective.

A table characterizing ships as above average, average, or below average in drill effectiveness at the IA and UD is supplied.

KEYWORDS: Data Analysis, Non-parametric Statistics
This thesis examines a 2015 Marine Expeditionary Brigade scheme of maneuver as the baseline scenario for a commercial logistics support software program called SEAWAY. Modifications to this scenario are conducted using a designed experiment in order to explore how the plan characteristics relate to eleven specified input factors. Multiple regression analysis is used to fit models to the resulting data for three different measures of performance: Total Aircraft Sorties, Total Aircraft Sortie Time, and Total Aircraft Tons. The results suggest the plan performance is predicted well by a small subset of the factors and their interactions.

One implication of this work is a better understanding of which factors are key determinants of the plan characteristics for variations on this specific base scenario. By using these fitted models, the number of SEAWAY runs needed to identify acceptable plans should decrease dramatically. The approach in this thesis provides a blueprint for similar analyses of other scenarios by demonstrating how information gained from models fit during an exploration phase might allow the logistician to quickly determine factor settings that yield an acceptable plan once details of an operation become available. Finally, working with the SEAWAY developers provided them with some new insights.

**KEYWORDS:** Agents-based Models, Seabasing, SEAWAY, Latin Hypercube Design, LHC Design, Scheme of Maneuver, SOM, Marine Expeditionary Brigade, MEB

**HOW TO OPTIMALLY INTERDICT A BELLIGERENT PROJECT TO DEVELOP A NUCLEAR WEAPON**

Eric M. Skroch-Lieutenant, United States Navy
B.S., Northwestern University, 1993
Master of Science in Operations Research-March 2004
Advisor: Gerald G. Brown, Department of Operations Research
Second Reader: Robert C. Harney, Department of Systems Engineering

Despite decades of energetic international control efforts, nuclear weapons technology continues to spread worldwide. To understand how these complex weapons programs can be developed, researchers assume the role of a nation seeking to build a first fission weapon, and the ability to continue to build more. A large-scale project management model that includes alternate development paths to achieve certain key technical milestones is introduced. It is shown how such a project can be optimally accelerated by expediting critical tasks. Next, a new analysis tool to detect vulnerabilities in such a development program is presented: optimal actions to impede, set back, and/or otherwise frustrate completion of a first weapon are sought, even if the proliferator knows what is being done to delay things. This two-sided project evaluation tool is implemented with a combination of commercial-off-the-shelf project management software, optimization software, and custom code. An illustrative case study of a first fission weapon program shows how this new analysis tool can be used. Methods used also apply to chemical, biological, and/or radiological dispersion weapons, as well as to more conventional strategic industrial and commercial activities.

**KEYWORDS:** Project Management, Network Interdiction, Nuclear Nonproliferation
The Free Electron Laser (FEL) has the potential to become a revolutionary weapon system. Deep magazines, low cost-per-shot, pinpoint accuracy, and speed of light delivery give this developing weapon system significant advantages over conventional systems. One limiting factor in high energy laser implementation is thermal blooming, a lensing effect which is caused by the quick heating of the atmosphere, so that the laser beam does not focus on the desired spot, thereby degrading the effectiveness of the laser on target. The use of multiple beam directors focusing on a target from a single platform may mitigate thermal blooming by allowing half of the laser’s energy to travel through a given volume of air, so that they only overlap very near the target. Less energy traveling through a given volume of space means less heating, and therefore lessens the effects of thermal blooming. Also, simulations of FEL’s were conducted modifying parameters such as the number of undulator periods, electron beam focus, the normalized Rayleigh length, and mirror output coupling, in order to determine optimum design parameters. Further, new parameters for the next proposed FEL were simulated to examine the effect of mirror tilt on laser power and extraction.

**KEYWORDS:** Free Electron Laser, Short Rayleigh Length, Directed Energy, Thermal Blooming, Multiple Beam Directors
Since the advent of Naval warfare, tactical Knowledge Management (KM) has been critical to the success of the On Scene Commander. Today’s Tactical Knowledge Manager typically operates in a high stressed environment with a multitude of knowledge sources, including detailed sensor deployment plans, rules of engagement contingencies, and weapon delivery assignments. However, the warfighter has placed a heavy reliance on delivering this data with traditional messaging processes while focusing on information organization vice knowledge management. This information oriented paradigm results in a continuation of data overload due to the manual intervention of human resources. Focusing on the data archiving aspect of information management overlooks the advantages of computational processing while delaying the empowerment of the processor as an automated decision making tool.

Resource Description Framework (RDF) and XML provide the potential for increased machine reasoning within a KM design, allowing the warfighter to migrate from the dependency on manual information systems to a more computational intensive KM environment. However, the unique environment of a tactical platform requires innovative solutions to automate the existing naval message architecture while improving the KM process. This thesis captures the key aspects for building a prototype KM Model and provides an implementation example for evaluation. The model developed for this analysis was instantiated to evaluate the use of RDF and XML technologies in the KM domain. The goal for the prototype included:

1. Processing required technical links in RDF/XML for feeding the KM model from multiple information sources.
2. Experiment with the visualization of KM processing vice traditional Information Resource Display techniques.

The results from working with the prototype KM Model demonstrated the flexibility of processing all information data under an XML context. Furthermore, the RDF attribute format provided a convenient structure for automated decision making based on multiple information sources. Additional research utilizing RDF/XML technologies will eventually enable the warfighter to effectively make decisions under a KM Environment.

MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

PROTOTYPE SYSTEM FOR DETECTING AND PROCESSING OF IEEE 802.11A SIGNALS
Che Seng Goh-Major, Republic of Singapore Air Force
B.E., Nanyang Technological University-Singapore, 1998
Master of Science in Systems Engineering-March 2004
Advisor: Tri T. Ha, Department of Electrical and Computer Engineering
Second Reader: Murali Tummala, Department of Electrical and Computer Engineering

As the need to send larger amounts of information increases, the military is looking into viable solutions to push this information throughout the battle space. IEEE 802.11a wireless LAN network presents an attractive high-speed solution by providing data rates up to 54 Mbps. At the same time, wireless LAN introduces increased security risk due to its vulnerability to exploitation of the wireless LAN physical layer.

In this thesis, a prototype system using a low cost hardware and software solution to detect and process wireless IEEE 802.11a signals was developed. The performance of the developed prototype was then tested and IEEE 802.11a performance data were collected to evaluate feasibility as a high-speed information network for military use. The collected performance data suggested that, while the range of the IEEE 802.11a network seemed limited when compared to those of IEEE 802.11b, the achieved data rate is several times higher than the maximum of 11 Mbps offered by 802.11b networks. The higher data rate of the IEEE 802.11a network would therefore be very useful in applications where high-speed wireless data exchange is required within a small operational area of up to 600 feet radius.

KEYWORDS: Wireless Transmission Protocol, IEEE 802.11a, Wireless LAN

PERFORMANCE ANALYSIS OF THE IEEE 802.11A WLAN STANDARD OPTIMUM AND SUB-OPTIMUM RECEIVER IN FREQUENCY-SELECTIVE, SLOWLY FADING NAKAGAMI CHANNELS WITH AWGN AND PULSED NOISE JAMMING
Christos Kalogrias-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1994
Master of Science in Electrical Engineering-March 2004
Master of Science in Systems Engineering-March 2004
Advisors: R. Clark Robertson, Department of Electrical and Computer Engineering
Donald V.Z. Wadsworth, Department of Electrical and Computer Engineering
and Space Systems Academic Group

The objective of this thesis is to investigate the performance of the orthogonal frequency division multiplexing (OFDM) based IEEE 802.11a wireless local area network (WLAN) standard receiver, when the signal is transmitted over a frequency selective, slow fading Nakagami channel in a worst case, pulse-noise jamming environment. The different combinations of modulation type (both binary and non-binary modulation) and convolutional code rate specified by the WLAN standard, are examined. Receiver performance with Viterbi soft decision decoding (SDD) is analyzed for additive white Gaussian noise (AWGN) alone, as well as for AWGN plus pulse-noise jamming (PJN). The performance of the IEEE 802.11a WLAN standard receiver is examined both for the scenario where perfect side information is assumed (optimum receiver) and when it is not (sub-optimum receiver). For the sub-optimum receiver scenario, the receiver performance is examined both when noise normalization is utilized and when only linear combining is utilized. The analysis indicates that the receiver performance is severely affected by the pulse-noise jamming environment for the linear combining scenario; however, the sub-optimum receiver performance is significantly improved when noise normalization is implemented.

KEYWORDS: IEEE 802.11a WLAN Standard, Nakagami Fading Channel, OFDM, Soft Decision Decoding, Pulse-noise Jamming, Perfect Side Information, Noise Normalization
DESIGN AND IMPLEMENTATION OF A DSP-BASED CONTROL INTERFACE UNIT
Andreas Kavousan-Kavousanakis-Lieutenant Junior Grade, Hellenic Navy
B.S., Hellenic Naval Academy, 1997
Master of Science in Electrical Engineering-March 2004
Master of Science in Systems Engineering-March 2004
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

In this thesis, the development of a human-body motion tracking system constructed with the use of commercial off-the-shelf (COTS) components is presented. The main component of the system investigated in this thesis is the Control Interface Unit (CIU). The CIU is a component designed to receive data from the magnetic, angular rate, and gravity (MARG) sensors and prepare them to be transmitted through a wireless configuration. Through this research, it was discovered that the MARG sensors had to be redesigned to overcome an erratum on the Honeywell magnetometer HMC1051Z data sheet. With the redesigned MARG sensors, the testing results showed that the CIU was performing extremely well. The overall motion tracking system is capable of tracking human body limb motions in real time.


STUDY OF WIRELESS TRANSMISSION PROTOCOL TECHNOLOGY FOR USE IN FLIGHT LINE ENVIRONMENT TO ASSIST THE DATA UPLOADING AND DOWNLOADING ON AIRCRAFT
Keong Meng Ow-Major, Republic of Singapore Air Force
B.E., Nanyang Technological University-Singapore, 1995
M.S., Nanyang Technological University-Singapore, 2002
Master of Science in Systems Engineering-March 2004
Advisor: Gilbert M. Lundy, Department of Computer Science
Second Reader: Donald V.Z. Wadsworth, Department of Electrical and Computer Engineering and Space Systems Academic Group

In this thesis, two state-of-the-art wireless transmission technologies are presented: Free-Space Optics (FSO) and the IEEE 802.11b protocol. Both are found suitable to complement or possibly replace the manual method of loading the critical data files onto the ALR-69 system. However, due to the short-range and low-budget requirement, the IEEE 802.11b protocol is more suitable and is therefore selected for this thesis work. The feasibility of incorporating and adapting the IEEE 802.11b technology for use in the flight line environment is examined. The propagation effect in wireless transmission is also studied and recommendations proposed with regard to the installation of wireless facilities in the flight line. In addition, the Enhanced Diagnostics Aid (EDNA) is proposed to be equipped and upgraded with an IEEE 802.11b wireless network card. The original operational concepts are contrasted against new operational concepts after incorporating the IEEE 802.11b wireless transmission technology. After incorporating the IEEE 802.11b wireless transmission upgrade, the new operational workflow yields a reduction of 245 minutes from the original timing of 409 minutes. The new operational workflow requires only 164 minutes for the same amount of F-16 aircraft with just one Radar Warning Receiver (RWR) Uploading Team.

KEYWORDS: IEEE 802.11b, EDNA, WLAN, FSO, Wireless Transmission Protocol, Radar Warning Receiver, F-16 Aircraft
Ground Penetrating Radars (GPRs), also known as subsurface radars, are used in many applications including detection of land mines and unexploded ordnance (UXO). Despite significant long-term investment in GPRs for mine and UXO detection, it remains true that no GPR system that meets operational requirements has yet been fielded; however, recent advances in several mine detection radars under development have produced significant improvements in detection performance and false-alarm mitigation over what was achievable only a few years ago. This research examines the suitability of modeling helical antennas to achieve a broadband characteristic for GPR implementation. Although the two-arm counter-wound helix provides the required spot illumination, it is expected that more arms may have to be added to reduce the radiation in the back direction and to match the input impedance to the feed line. Microwave Design Studio (MDS) has been used extensively to simulate the broadband characteristics of the helical antenna. An overall design strategy is outlined, together with a more detailed treatment of the ground penetrating radar subsystems and topics that are relevant to effective subsurface radar operation. These include soil characterization, the choice of the frequency of operation, as well as the design and construction of suitable helical antennas.

The research investigated the factors contributing to the performance of the GPR radar system which resulted in a new antenna design, the CQHA, which is capable of dual-linear polarization over a wide bandwidth. The thesis discussed the various tradeoffs that must be made in addition to their implications for an overall improved design. The helical antenna for GPR applications was studied in detail. Parameters describing the helix were defined; their range of values for both the normal and axial modes was specified. The axial mode helix demonstrated the desirable characteristics necessary for an antenna for subsurface radar applications. The characteristics can be varied by controlling the parameter values relative to the wavelength. By adding more arms, it was revealed that wider bandwidth and radiation in the back direction can be suppressed. Linear polarization was achieved by adding a second set of windings that are wound in an opposite sense to those of the first set, as demonstrated for the counter-wound quadrifilar helical antenna. The wave can be made horizontally or vertically polarized by varying the delay to the antenna feeds. This design allows buried objects with unknown aspect angle with respect to the antenna, to be detected by the radar system without large polarization loss. The CQHA design may be extended to other applications where large antenna bandwidth is required.

KEYWORDS: Subsurface Radar, Ground Penetrating Radar, GPR, Helical Antennas, Helix, Ground Dielectric Properties

PERFORMANCE ANALYSIS OF THE EFFECT OF PULSED-NOISE INTERFERENCE ON WLAN SIGNALS TRANSMITTED OVER A NAKAGAMI FADING CHANNEL
Andreas Tsoumanis-Lieutenant Junior Grade, Hellenic Navy
B.S., Hellenic Naval Academy, 1996
Master of Science in Systems Engineering-March 2004
Master of Science in Electrical Engineering-March 2004
Advisors: R. Clark Robertson, Department of Electrical and Computer Engineering
Donald V.Z. Wadsworth, Department of Electrical and Computer Engineering and Space Systems Academic Group

This thesis examines the performance of wireless local area network (WLAN) signals, specifically, the signal of IEEE 802.11a standard. The signal is subject to pulsed-noise jamming, when either the desired signal alone or the desired signal and the jamming signal are subject to Nakagami fading. As expected, the implementation of forward error correction (FEC) coding with soft decision decoding (SDD) and maximum-likelihood detection improves performance as compared to uncoded signals. In addition, the combination of maximum-likelihood detection and error correction coding renders pulsed-noise jamming ineffective as compared to barrage noise jamming. When the jamming signal encounters fading as well, it
is assumed that the average jamming power is much greater than the AWGN power. For uncoded signals, a jamming signal that experiences fading actually improves performance when the parameter of the information signal $m_s$ is less than or equal to one. Surprisingly, for larger values of $m_s$, a jamming signal that experiences fading works in favor of the information signal only for small signal-to-interference ratio (SIR). When SIR is large, performance when the jamming signal experiences fading is worse relative to performance when the jamming signal does not experience fading. For error correction coding with SDD, only continuous jamming is investigated, since it is by far the worst-case. Moreover, while a range of fading conditions for the jamming signal are considered, only Rayleigh fading of the information signal is examined. The coded signal, when the jamming signal experiences severe fading, performs better relative to the case when the jamming signal does not experience fading.

**KEYWORDS:** IEEE 802.11a, WLAN, FEC, SDD, OFDM, BPSK, QPSK, MQAM, AWGN, Nakagami, Soft Decision Decoding, Convolutional Code, Pulsed-noise Jamming, Probability of Bit Error
This thesis strives to illustrate how a C4I system modeled in a Massive Multiplayer Online Games (MMOG) can aid designers in gathering insights on the effectiveness of the system in various combat situations. The insights will be gathered through the interactions of players with the modeled system in the virtual environment. The human interaction with the modeled C4I system provides the ability to capture the effects of the C4I system on the warfighter. The resultant effects of the C4I system on the warfighter directly contribute to the overall combat effectiveness of the deployed military forces. The background of MMOGs and C4I systems and attributes that are desirable in evaluating C4I systems are introduced and discussed. FORCEnet, a global C4I architecture still in the conceptual phase, is then used as an example to illustrate the potential rewards to using MMOGs to evaluate C4I systems.

**KEYWORDS:** Massive Multiplayer Online Games, MMOG, Virtual Environments, C4I Systems, FORCEnet, FnEP
MASTER OF ARTS

National Security Affairs
Security Studies
DEMOCRATICALLY ELECTED SOCIALIST PRESIDENTS AND FREE-MARKET REFORMS:  
A POLITICAL ECONOMY EXAMINATION 
Jeremy J. Aujero-Lieutenant, United States Navy  
B.S., Oregon State University, 1997  
Master of Arts in National Security Affairs-March 2004  
Advisor: Robert Looney, Department of National Security Affairs  
Second Reader: Harold Trinkunas, Department of National Security Affairs  

Left-of-center parties are rhetorically against liberalizing markets, but historical evidence proves otherwise in certain situations. The United States is vitally interested in the democratic and economic success of developing countries, as stated in United States national security strategy. This thesis uses economic institutionalism to examine the occasions on which left-of-center presidents successfully implemented neoliberal economic reforms. Case studies of Chile under President Patricio Aylwin and Brazil under Fernando Henrique Cardoso are used as evidence.  

KEYWORDS: Politics, Presidents, Economy, Economic Reform, Institutions, Neoliberalism, Country Studies

NATO AND THE WAR ON TERRORISM: OBJECTIVES AND OBSTACLES 
Nathaniel A. Bailey-Lieutenant, United States Navy  
B.S., United States Naval Academy, 1998  
Master of Arts in National Security Affairs-March 2004  
Advisor: David S. Yost, Department of National Security Affairs  
Second Reader: Colonel Hans-Eberhard Peters, German Air Force  

This thesis examines the role of the North Atlantic Treaty Organization (NATO) in the Global War on Terrorism. It focuses on NATO’s objectives as well as the obstacles to its active and effective participation in countering this new security challenge. The thesis first analyzes NATO’s response to the terrorist attacks against the United States on 11 September 2001, and the resulting transformation in NATO’s strategic focus and capabilities, which is designed to ensure its relevance in the new security environment. The thesis then examines the key political and military factors that might, in some circumstances, undermine the Atlantic Alliance and hinder the important task of combating terrorism and the proliferation of weapons of mass destruction. These factors constitute challenges that must be successfully met for the Atlantic Alliance to play a strong role in the war on terrorism.  

KEYWORDS: NATO, Terrorism, Global, Transformation, Capabilities, Afghanistan, Iraq, Preemption, Deployability
SAUDI SECURITY: CHALLENGES FOR THE POST-SADDAM ERA
David M. Burke-Captain, United States Air Force
B.A., College of Charleston, 1995
M.P.S., Auburn University Montgomery, 1998
Master of Arts in National Security Affairs-March 2004
Advisor: James A. Russell, Department of National Security Affairs
Second Reader: W. Andrew Terrill, United States Army War College

Events at the beginning of the 21st century have brought a fundamental change to the security environment in the Kingdom of Saudi Arabia of a significance not witnessed in the region since the Iranian Revolution in 1979. The fall of Saddam Hussein’s regime in 2003 eliminated the most significant external threat facing Saudi Arabia. At the same time, internal threats to the Kingdom appear to be increasing. The demographic and economic challenges facing the Kingdom are contributing to internal instability. Increased instances of political violence, particularly suicide bombings against targets within the Kingdom, have been carried out by terrorists linked to al-Qaeda. These attacks have targeted Westerners and, for the first time in May 2003, non-Saudi Muslims.

This paper examines the security challenges facing Saudi Arabia at the start of the 21st century. Arguments are made that while external threats to the Kingdom remain, the greater threat to security may lie within the Saudi state: the result of a failure to address current political realities. Major security challenges include the threat from Iran, economic and demographic pressures, the question of succession within the ruling al-Saud family, and maintaining the U.S.-Saudi security partnership, a relationship which has endured over 50 years.

KEYWORDS: Saudi Arabia, Persian Gulf Security

ORGANIZED CRIME AND NATIONAL SECURITY: THE ALBANIAN CASE
Ilir Gjoni-Member of Parliament, Republic of Albania
B.A., Tirana University, 1985
Master of Arts in National Security Affairs-March 2004
Advisor: Jeff Knopf, Department of National Security Affairs
Second Reader: Robert Looney, Department of National Security Affairs

This thesis argues that organized crime constitutes a threat to democracy in Albania, and consequently to the national security of the country. Organized crime is considered a phenomenon that is corroding democratic institutions. Corruption of government and law enforcement agencies and the merging of organized crime with the state machinery presents a major threat to democracy and the national security of the country. This thesis analyzes the emergence of organized crime in Albania, its root causes, structure and activities, and threats posed by organized crime to the national security of Albania. Recommendations are provided on how to tackle the issue of organized crime in Albania.

KEYWORDS: Organized Crime, Corruption, Drugs, Arms and Human Trafficking, Law Enforcement, Democracy

THE FUTURE OF THE U.S. NAVY IN THE PERSIAN GULF
Austin C. Johnson-Lieutenant, United States Navy Reserve
B.A., San Diego State University, 1999
Master of Arts in National Security Affairs-March 2004
Advisors: Daniel Moran, Department of National Security Affairs
James A. Russell, Department of National Security Affairs

This thesis analyzes a range of possible future scenarios of security conditions in the Persian Gulf, in order to determine future requirements for forward-deployed Naval forces in the region. Examination of the past 30 years of U.S. Naval activity in the Persian Gulf provides examples of a full spectrum of deployment options, ranging from a nominal presence in the 1970’s to the recent deployment of forces unmatched in
Naval history. Two contrasting scenarios, “best case” and “worst case,” are proposed by way of establishing a framework to evaluate the Naval presence requirements that may arise in the future. Factors that could affect Naval presence in the Gulf are success or failure of nation-building in Iraq, the path Iran takes regarding weapons of mass destruction, the progress of the Global War on Terrorism, and the perception of American forces by the Arab world. These scenarios reveal the need for a sustained Naval presence in order to meet the future trends in the Persian Gulf. The Navy’s recently implemented Fleet Response Plan calls for “deployment for a purpose.” The purpose of Naval forces in the Persian Gulf is clear: to provide persistent maritime dominance, power projection, and effective crisis response.

KEYWORDS: Naval Operations, Persian Gulf, Naval Strategy, Fleet Response Plan, Surge

WHAT CAN THE UNITED STATES LEARN FROM INDIA TO COUNTER TERRORISM?
William S. Latimer-Captain, United States Air Force
B.A., Brigham Young University, 1996
Master of Arts in National Security Affairs-March 2004
Advisor: Peter R. Lavoy, Department of National Security Affairs
Second Reader: Surinder Rana, Department of National Security Affairs

Terrorism is the principal threat to global and national security in the post-11 September world. Facing terrorist threats at home and abroad, the United States has declared counterterrorism its top priority. As the United States embarks on its global counterterrorism campaign, it must draw on the experience of other countries. Specifically India, with an extensive history of counterterrorism efforts, can reveal important lessons applicable to America’s endeavors. India offers three primary examples of counterterrorism strategies: Punjab, its northeast region, and Kashmir, from which four findings emerge. First, aggressive military operations are central to beating terrorism. Second, economic and social development programs, though not enough to end terrorism alone, are essential components of the larger national strategy. Third, terrorism cannot be stopped without international assistance. Terror networks export personnel, knowledge, weapons, and money across international boundaries with growing frequency. This cannot be effectively stopped without a coordinated national and international effort. Fourth, to be successful, a counterterrorism strategy must engender the public’s support for the government and promulgate a sense of public ownership to the conflict. By applying these lessons from the Indian case study, America’s efforts to end terrorism both domestically and internationally may be significantly more productive.


JAPAN’S STRATEGIC FUTURE: COALITION OPERATIONS
Robert Y. Shu-Lieutenant, United States Navy
B.A., Oregon State University, 1997
B.S., Oregon State University, 1997
Master of Arts in National Security Affairs-March 2004
Advisor: Edward A. Olsen, Department of National Security Affairs
Second Reader: Michael T. McMaster, Naval War College

The evolution of the Japanese Self-Defense Force (JSDF) over the past fifty years has created debate in Japan's Parliament over its legality, purpose, direction, and normalization. The JSDF appears to be taking steps to "normalize." If so, what are the indicators and have any of the steps been achieved? This thesis seeks to analyze the trends of the JSDF in its evolution from a National Police Reserve to a self-defense force as to the roles and missions that it has chosen to accept or reject. Also, the issues that arise out of Article 9 in Japan's Constitution will be examined to determine if there is a conflict in interpretation. Japan's major political parties' views on Article 9 and the JSDF will be presented in order to determine where they stand on the issues. Japan's regional neighbors and their possible reactions to a normalization of the JSDF will be presented, in addition to other factors that will either aid or impede the normalization of
the JSDF. Finally, recommendations regarding the United States’ approach to engaging a normalized Japan will be presented.

**KEYWORDS:** Japan, Constitution, JSDF, Transformation, Normalization

### PAKISTAN'S KASHMIR POLICY AND STRATEGY SINCE 1947

**Matthew P. Taylor-Captain, United States Air Force**  
B.A., University of California-Santa Barbara, 1997  
Master of Arts in National Security Affairs-March 2004  
Advisor: Peter R. Lavoy, Department of National Security Affairs  
Second Reader: Feroz Khan

This thesis analyzes Pakistan’s Kashmir policy and strategy since 1947. Pakistan has sought to obtain the accession of Kashmir for over fifty years. This policy has its origins in Pakistan’s struggle for a separate state for South Asia’s Muslims, its belief that India never accepted Pakistan’s existence, and Pakistan’s domestic cleavages and institutional weaknesses. Because these beliefs and characteristics remain today, Pakistan is unlikely to drop its claim to Kashmir. Pakistan’s strategy to achieve its objectives has included diplomacy, war, and proxy war. This thesis explores how internal and external variables have impacted Pakistan’s methods and what this means for the current effort to end the proxy war in Kashmir. Although Pakistan is unlikely to abandon its claims to Kashmir, an analysis of Pakistan’s shift from diplomacy to war in 1965 and from diplomacy to proxy war in 1990 demonstrates that Pakistan’s strategy responds to external constraints and opportunities. The United States may not be able to end the dispute over Kashmir by pressuring Pakistan to drop its claims, but Washington retains sufficient influence to persuade Pakistan to use a peaceful strategy to pursue its claims to Kashmir.

**KEYWORDS:** Kashmir, Pakistan, Strategy, Policy, U.S.-Pakistan Relations, Proxy War, South Asia, Islamist

### SHIELDING ACHILLES' HEEL: CHALLENGES FACING NORTHCOM IN THE MARITIME DOMAIN

**Carlos Urbizu-Lieutenant, United States Navy**  
B.A., Auburn University, 1997  
Master of Science in Applied Mathematics-June 2001  
Master of Arts in National Security Affairs-March 2004  
Advisor: Richard M. Brown, III, Naval War College  
Second Reader: James A. Russell, Department of National Security Affairs

This thesis examines the role U.S. Northern Command (NORTHCOM) is performing in the maritime domain as the new Unified Command responsible for homeland defense. NORTHCOM does not currently have a permanent maritime component assigned for missions. Instead, it relies on contingency planning for future events and theoretically acts as a coordinating bridge between the Navy and Coast Guard for Maritime Homeland Defense/Security (HLD/HLS) issues.

The primary objective of this research is to answer the question: Can NORTHCOM effectively execute maritime homeland defense and support homeland security without having permanently assigned maritime forces?

Secondly, this thesis seeks to scrutinize the seam in transition from Maritime Homeland Security to Maritime Homeland Defense and explicate potential mission priority, service capability, and geographic and cultural mismatches which could potentially stymie command and control in the transition from an HLS to HLD posture in the event of a seaborne terrorist attack.

Since the end of the Cold War, Mongolia has enjoyed a new security environment that offers both a genuine opportunity to determine its national security and unavoidable uncertainties that accompany all transitions to democracy. Entering the new environment, the nation was faced with the urgent need to form new policies to meet those uncertainties and establish adequate institutions to implement them. Mongolia, as most small nations with greater vulnerability, sees its security and survival in all dimensions: from the physical strength to deter invasion by a military force to survival of its ethnical identity in the face of potential assimilation by populous neighbors. Such a broad definition of national security requires participation of all elements of the society in the security process, thus an adequate system able to manage such broad involvement becomes vital. Mongolia has successfully managed to establish a relatively efficient and complex system for national security management. The National Security Council (NSC) is the only state institution responsible for the coordination of the nation’s effort to ensure its security. However, despite the clear definition of the legal status of the National Security Council provided by legal acts, there is a persistent, but incorrect, popular feeling that the National Security Council is a presidential institution and that the President enjoys the prerogative of orchestrating the nation’s effort to ensure its security. This thesis argues coordinative functions will be more efficient if the NSC will properly maintain its independent, non-attached status, and its immediate supportive institutions, the Executive Secretary and the Office, serve as non-partisan, independent, and purely professional units devoted to serving only the interests of national security.

KEYWORDS: Mongolia, National Security, National Security Council, Coordination, Elaboration, Supervision

Since 1989, the countries of Central and Eastern Europe have undergone an unprecedented transition from communism to democracy. Establishment of democratic control of armed forces is an inseparable part of the process of consolidation of democracy. The purpose of this thesis is to define those factors that influence democratization of civil-military relations in post-communist countries in the process of transition to democracy. The argument is made that countries develop democratic control of armed forces in different ways and with different time boundaries until the end state is achieved. The democratization of civil-military relations depends on the capability of the country in transition to effectively establish (meaning build and put into effect) institutions for the democratic control of the military.
SECURITY STUDIES

In evaluating development of the democratization of civil-military relations, the post-communist countries of Hungary and Bulgaria are studied in detail with particular attention paid to the process of establishment, development, and interrelation of institutional arrangements. In this aspect, historical legacy, international context, and path of transition can help or obstruct the process of development of institutions for the democratic control of armed forces.

KEYWORDS: Bulgaria, Hungary, Civil-Military Relations, Democratic Control of Armed Forces

Taras B. Katerychenchuk-Major, Ukrainian Army
M.A., Academy of the Armed Forces of Ukraine, 1997
Master of Arts in Security Studies (Civil-Military Relations)-March 2004
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Colonel Hans-Eberhard Peters, German Air Force

This thesis provides a critical analysis of the development of the military staff officer education and training system in Ukraine. The chronological scope of research includes a period from January 1992 to December 1998. The research examines the status of officer training after the collapse of the Soviet Union and the reasons for the creation of a national higher military school in Ukraine. The research also covers the evolution of ideas and opinions on Ukraine's creation of its modern system of officer personnel training from 1992-1998. This thesis traces the process of the creation of the national system of the officer personnel training and its influence on the organization of the Armed Forces of Ukraine. It examines the roles of influential bodies of State power and military authorities in solving the conceptual questions of reforming the system of higher military education. The author describes and provides an interpretation of the events, facts, and phenomena related to the creation of the officer personnel training system and its influence on the creation of the Armed Forces of Ukraine.

KEYWORDS: Military Education System, Curricula, Military Educational Institutions, Military Training, Civil-Military Relations, Ukraine

THE INFLUENCE OF ISLAM IN THE MILITARY: COMPARATIVE STUDY OF MALAYSIA, INDONESIA AND PAKISTAN
Ab Razak bin Mohd Khairan-Lieutenant Colonel, Royal Malaysian Air Force
Advance Diploma, Malaysian Defense College, 2001
Master of Arts in Security Studies (Civil-Military Relations)-March 2004
Advisors: Gaye Christofferson, Department of National Security Affairs
Seyyed Vali Reza Nasr

Following the revival of Islam, Islam permeates the military institutions of Malaysia, Pakistan, and Indonesia and has replaced the Western and foreign military cultures the military had inherited.

The implementation of true Islamic model practices and values differ slightly from country to country, depending first on the level of piousness of its existing military personnel, new personnel input, and the military leadership. The second factor is the degree of motivational drive of the head of state in encouraging Islam. Islamized military institutions are also faced with the challenges created as a result of sects and schools that emerge in the form of Islamic parties and extremist groups.

The argument will be that Islamic teachings in military affairs can result in peace, solidarity, and a solution to the Civil-Military Relations (CMR) problems. In the final analysis, “guided moderate Islamic influence” can bring harmony to CMR in Malaysia, while the uncoordinated influence of Islam in the Indonesian military makes the CMR problematic. It is different in Pakistan because the strong influence of Islam has encouraged the generals to wrest political power from civilians.

KEYWORDS: Military, Military Institution, Islamization, Civil-Military Relations, Malaysia, Indonesia, Pakistan, Civilian Control
PAPUAN ETHNO-POLITICAL CONFLICT: CAUSES, CONTEXTS, AND POLICY IMPLICATIONS
Arifah Rahmawati-Civilian, Ministry of Education of Indonesia
B.A., Gadjah Mada University of Yogyakart-Indonesia, 1992
Master of Arts in Security Studies (Security Building in Post-Conflict Environment)-March 2004
Advisor: Douglas Porch, Department of National Security Affairs
Second Reader: Gaye Christofferson, Department of National Security Affairs

This thesis examines causes and contexts of conflict in the Papuan province of Indonesia. The Papua conflict is categorized as an ethno-political conflict, as various ethnic groups differ in their views of the government of Indonesia. They express their political ideas with actions ranging from rebellion to non-violent political campaigns. At the same time, the Indonesian government has chosen various policies, from counter-insurgency to accommodation. The counter-insurgency policies, however, have escalated the conflict and brought more grief to the Papuans, which has increased international concerns. Thus, this thesis argues for a peaceful resolution of the Papua conflict through negotiation and accommodation. The thesis also expects the active engagement of the civil society at the local, national, and international levels.

KEYWORDS: Papua Province, Indonesia, Papua Conflict, Ethno-political Conflict, Counter-insurgency, Accommodation, Civil-society

CIVIL-MILITARY RELATIONS IN UKRAINE DURING THE TRANSITION FROM THE SOVIET UNION TO THE INDEPENDENT UKRAINIAN REPUBLIC
Oleksandr Sharyi-Captain, Ukrainian Army
B.S., Kiev Institute of the Land Forces, 1998
Master of Arts in Security Studies (Civil-Military Relations)-March 2004
Advisor: Thomas C. Bruneau, Department of National Security Affairs
Second Reader: Anne Clunan, Department of National Security Affairs

This thesis analyzes three case studies that chronologically review the main factors influencing the creation of the system of civil control over the Armed Forces of the Ukraine. The first case analyzes the period of time before the collapse of the Soviet Union. The second case examines the creation of the Armed Forces of the Ukraine from 1991 until 2000. The third case reviews the present system of civil-military relations in the Ukraine. The conclusion summarizes all findings of the three case studies and states that neglect of defense issues today will lead to the risk of losing statehood tomorrow or shifting responsibility and financial burden to future generations. Only a well funded and well-defined program of reform can help build a modern, highly capable, professional, western-type Armed Forces with civilian control over the military. The Ukraine has great experience in building and reforming its military structure and system of civil control. The best proof of this is that the Ukraine prevented involvement of the army in politics.

KEYWORDS: Armed Force of Ukraine, Civil-Military Relations, Ukraine
NATO’S GLOBAL ROLE: TO WHAT EXTENT WILL NATO PURSUE A GLOBAL ORIENTATION?
Miroslav vejda-Lieutenant Colonel, Czech Armed Forces
Engineer, Military Academy in Brno and Liptovsk Mikulá-Czechoslovakia, 1981
Master of Arts in Security Studies (Civil Military Relations)-March 2004
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Colonel Hans-Eberhard Peters, German Air Force

The geopolitical change and emergence of new threats, notably terrorism and the proliferation of weapons of mass destruction, forced a reappraisal of the political and security roles of the North Atlantic Treaty Organization (NATO). The Alliance’s post-Cold War development, operations in the Balkans, and differences across the Atlantic also provided grounds for a revision of NATO’s purely self-defense dimension. The Alliance, after having permanent out-of-area debates, has realized that it can no longer be circumscribed by artificial geographic boundaries to meet the future. At its summit in Prague in 2002, NATO initiated a new concept transforming itself into an effective organization with a global approach. By establishing the NATO Response Force, balancing the burden-shifting, and opening the security dialog among likeminded allies, NATO renewed the essence of common transatlantic values. By analyzing NATO’s role and its prevailing tendencies, this thesis contends that NATO is no longer a regional security organization but a collective security instrument with its first front abroad, in the Greater Middle East and Northern Africa. However, if NATO is to contribute profoundly to international peace, it needs an institutional framework with global legitimacy.


“UNPACKING AND REARRANGING THE BOXES”: THE SEARCH FOR A NEW INSTITUTIONAL MATRIX OF DEMOCRATIC CONTROL OF THE MILITARY IN BOTSWANA
Laki S. Thaga-Captain, Botswana Defense Force
B.A., University of Botswana, 1997
Master of Arts in Security Studies (Civil Military Relations)-March 2004
Advisor: Letitia Lawson, Department of National Security Affairs
Second Reader: Thomas C. Bruneau, Department of National Security Affairs

Botswana has been hailed as a “model of success,” an “African Miracle,” and a “rare bird in Africa” because of its economic prosperity record and democratic achievements in a region of sharp contrasts. A well-developed bureaucracy, selfless leadership, and a favorable diamond-led economy have been identified as the main drivers of this success. Its military has earned international acclaim for being professional, well trained and highly disciplined. Organized into four chapters, this thesis recognizes these achievements, but draws the reader to an equally important aspect of statecraft, the underdevelopment of a defense bureaucracy, that may undermine the country’s democratic gains and its economic prosperity. Chapter I proposes an institutionalist conceptual framework to the contemporary landscape of civil-military relations. Chapter II locates the evolution of the military within the template of statecraft, highlighting professionalization as a strategy of military development in the absence of a coherent defense bureaucracy and weak institutions of democratic oversight. The chapter underlines potential dangers of this institutional matrix to civil-military relations and governance. Chapter III captures the evolution of the state amidst elite cohesion and economic growth, demonstrating how these contrasts affect governance in general and civil-military relations in particular. Finally, Chapter IV advances a new institutional matrix for democratic control of the military.

KEYWORDS: Democratic Control of the Military, Botswana
This study focuses on the history of relations between the Serbs and Albanians in Kosovo during a relatively extensive period, starting with the demise of the Ottoman Empire to the present. This thesis examines the process of the division of Kosovo society along ethnic, cultural, and religious lines, which eventually made possible the seizure of power by nationalistic conservatives.

This study investigates both Serbian and Albanian nationalism and speculates on why nothing had been done by the elite to contain the conflict in the first place. It seeks to explore the origins of the modern conflict and identifies the decisive factors that influenced the development of contradicting positions of two peoples, which eventually led to open hostilities in 1998-99.

The thesis employs a descriptive approach and reviews contemporary scholarly literature dedicated to the subject.

KEYWORDS: Inter-ethnic Conflict, Nationalism, Balkans, Federative Republic of Yugoslavia, Kosovo
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Spring 2004
INTRODUCTION

Mission
The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

Increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.

The research program at NPS exists to support the primary mission of graduate education. Research at NPS:
• maintains upper division course content and programs at cutting edge;
• challenges students with creative problem solving experiences on DoD relevant issues;
• advances DoN/DoD technology;
• solves warfare problems; and
• attracts and retains quality faculty.

Academic Programs
To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization tying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has aligned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer’s career.

3 Institutes

The Cebrowski Institute for Information Innovation and Superiority
Modeling, Virtual Environments, and Simulation (MOVES)
The Wayne E. Meyer Institute of Systems Engineering

4 Schools

Graduate School of Engineering and Applied Science
Graduate School of Operational and Information Sciences
Graduate School of Business and Public Policy
School of International Graduate Studies

Institutes ensure that education provided by the schools is applied to military challenges

Core Characteristics
• Integrated
• Systems-Oriented
• Partnered for strength
• Flexible
INTRODUCTION

Programs of Graduate Studies at NPS are grouped as follows:

**Graduate School of Operational and Information Sciences**
- Computer Science
- Computers and Intelligence (C4I) Systems
- Electronic Warfare Systems International
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Operations Analysis
- Operations Logistics
- Software Engineering
- Special Operations/Low Intensity Conflict

**Graduate School of Engineering and Applied Sciences**
- Combat Systems Science and Technology
- Electrical Engineering
- Electronic Systems Engineering
- Engineering Acoustics
- Meteorology
- Meteorology and Oceanography
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors/Mechanical Engineering

**Graduate School of Business and Public Policy**
- Acquisition and Contract Management
- Contract Management
- Defense Systems Analysis
- Defense Systems Management (International)
- Financial Management
- Information Systems Management
- Leadership Education and Development
- Manpower Systems Analysis
- Material Logistics Support Management
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Transportation Management

**School of International Graduate Studies**
- Civil-Military Relations
- Defense Decision Making and Planning
- Homeland Security Leadership Development
- National Security and Intelligence
  - Europe/Russia/Central Asia
  - Far East/South-East Asia/Pacific
  - Middle East/Africa/South Asia
  - Western Hemisphere

**Interdisciplinary Curricula**
- Modeling, Virtual Environments, and Simulation
- Product Development
- Space Systems Engineering
- Space Systems Operations
- Space Systems Operations International
- Systems Engineering and Analysis
- Systems Engineering Management
- Undersea Warfare

**Students**
The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government and military officers and government civilian employees of other countries. Resident degree/subspecialty student population for June 2004 is shown in Figure 1 on the following page.
INTRODUCTION

Figure 1: Resident Degrees/Subspecialty Student Population for June 2004
(Total Enrollment: 1,522)

*U.S. Coast Guard, U.S. Army National Guard, U.S. Army Reserve

Academic Degrees
Although the curricula are tailored to address defense requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a master’s degree; however, additional study can lead to either an engineer’s degree or the doctor’s degree. Below is a listing of the degrees offered at NPS:

Master of Arts Degrees
National Security Affairs
Security Studies

Master of Business Administration
Executive MBA
Master of Business Administration

Master of Science Degrees
Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Combat Systems Technology
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Systems and Operations
Information Technology Management
Leadership and Human Resource Development
Management
Materials Science and Engineering
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Product Development
Program Management

Engineer Degrees
Astronautical Engineer
Electrical Engineer
Mechanical Engineer

Doctor of Philosophy
Applied Mathematics
Applied Physics
Astronautical Engineering
Computer Science
Electrical Engineering
Engineering Acoustics
Information Science
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Software Engineering

Doctor of Engineering
Astronautical Engineering
Engineering Acoustics
Mechanical Engineering
There were 236 degrees conferred in June 2004. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.

*Ph.D. Electrical Engineering (1); Ph.D. Meteorology (1); Ph.D. Modeling; Virtual Environments and Simulation (1); M.S. Applied Mathematics (1); M.S. Astronautical Engineering (1); M.S. Contract Management (1); M.S. Engineering Science (1); M.S. Information Systems Technology (1); M.S. Meteorology (1); M.S. Physics (1); M.S. Space Systems Operations (1); M.S. Physical Oceanography (2); M.S. Systems Engineering (2).
**INTRODUCTION**

**Thesis**
The thesis is the capstone achievement of the student’s academic endeavor at NPS. Thesis topics address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Students, with their faculty advisors, provide a very unique capability within the DoD for addressing warfighting problems. This capability is especially important at the present time when technology in general, and information operations in particular, are changing rapidly. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are rapidly being developed in both the commercial and military sectors. Their unique knowledge of operations, when combined with a challenging thesis project which requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet/Joint Force problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.

![Figure 4. Classification of Theses](image-url)
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ADVANCED DEGREES

Doctor of Philosophy
Mechanical Engineer
Several issues associated with vertical grid resolution and the turbulence parameterization in mesoscale models are addressed in this study. Of particular concern is the issue of cloud top entrainment, the entrainment fluxes, and the impact entrainment has on boundary layer development and inversion strength. These issues are studied through careful analysis of in situ data and mesoscale simulations. In this study, observations are analyzed to better understand the evolution of the marine boundary layer in various environmental conditions. The capability of the U.S. Navy’s current Coupled Ocean-atmosphere Mesoscale Prediction System (COAMPS\textsuperscript{TM}) is then explored, using real case studies of summertime conditions along the California coast. The model’s ability to accurately represent the boundary layer turbulence mixing at vertical resolutions feasible for operational prediction is analyzed. Based on results from the above analysis, the existing parameterizations are modified towards more realistic representations of the cloud top processes and these modifications are shown to improve COAMPS\textsuperscript{TM} predictions in this regime.

**KEYWORDS:** Entrainment, Cloud-topped Marine Boundary Layer, Mesoscale Modeling, COAMPS\textsuperscript{TM}
As leaders of the Department of Defense (DoD) rely more on modeling and simulation (M&S) to provide information on which they base strategic and tactical decisions, the credibility of simulations becomes more important. This credibility is initially gained through the verification, validation, and accreditation process DoD models are required to undergo prior to their use in simulations. The process of validating behavioral models is not well defined, nor is the process extendable to meet requirements for validating the varied and complex behavioral models. Through a series of empirical studies, this research identifies subject matter expert (SME) biases and their effects on consistency and accuracy of results. This research concludes that a SME’s bias has a statistically significant effect on subjective assessment of human performance of urban combat skills. To this end, the research demonstrates how the effects of the natural biases of SMEs can be mitigated based on the scale used to assess human behavior representation (HBR) models, providing a more consistent and accurate means of validating HBR models. In doing so, it assists the DoD M&S community by providing enhancements to validation procedures for assessing HBR model implementations for future use in DoD legacy and developmental combat models.

The performance of coherent and non-coherent RAKE receivers over a fading channel in the presence of pulse-noise jamming and additive white Gaussian noise is analyzed. Coherent RAKE receivers require a pilot tone for coherent demodulation. Using a first order phase-lock-loop to recover a pilot tone with additive white Gaussian noise causes phase distortions at the phase-lock-loop output, which produce an irreducible phase noise error floor for soft decision decoding. Both coherent and non-coherent RAKE receivers optimized for additive white Gaussian noise perform poorly when pulse-noise jamming is present. When soft decision convolutional coding is considered, the performance degrades as the duty cycle of the pulse-noise jamming signal decreases. The reverse is true for hard decision decoding, since fewer bits are jammed and bit errors with high noise variance cannot dominate the decision statistics. A soft decision RAKE receiver optimized for pulse-noise jamming and additive white Gaussian noise performed the best for both the coherent and non-coherent RAKE receivers. This receiver scales the received signal by the inverse of the variance on a bit-by-bit basis to minimize the effect of pulse-noise jamming. The efficacy is demonstrated by analytical results, revealing that this receiver reduces the probability of bit error down to the irreducible phase noise error floor when pulse-noise jamming is present. This demonstrates how important it is to design the receiver for the intended operational environment.

**KEYWORDS:** RAKE, Noncoherent RAKE, Interference, Pulse-noise, Phase Noise, Coding
NUMERICAL PREDICTION OF THE IMPACT OF NON-UNIFORM LEADING EDGE COATINGS ON THE AERODYNAMIC PERFORMANCE OF COMPRESSOR AIRFOILS

Michael E. Elmstrom-Lieutenant Commander, United States Navy
B.M.E, Georgia Institute of Technology, 1990
Mechanical Engineer-June 2004
Master of Science in Mechanical Engineering-June 2004
Advisor: Knox T. Millsaps, Department of Mechanical and Astronautical Engineering
Second Reader: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

A computational fluid dynamic (CFD) investigation is presented that provides predictions of the aerodynamic impact of uniform and non-uniform coatings applied to the leading edge of a compressor airfoil in a cascade. Using a National Advisory Committee for Aeronautics (NACA) 65(12)10 airfoil, coating profiles of varying leading edge non-uniformity were added. This non-uniformity is typical of that expected due to fluid being drawn away from the leading edge during the coating process. The CFD code, RVCQ3D, is a steady, quasi-three-dimensional Reynolds Averaged Navier-Stokes (RANS) solver. A k-omega turbulence model is used for the Reynolds’ Stress closure. The code predicts that these changes in leading edge shape can lead to alternating pressure gradients in the first few percent of chord that create small separation bubbles and possibly early transition to turbulence. The change in total pressure loss and trailing edge deviation are presented as a function of the coating non-uniformity parameter. Results are presented for six leading edge profiles over a range of incidences and inlet Mach numbers from 0.6 to 0.8. The Reynolds number was 600,000 and free-stream turbulence was 6%. A two-dimensional map is provided that shows the allowable degree of coating non-uniformity as a function of incidence and inlet Mach number.

KEYWORDS: Compressor Aerodynamics, Leading Edges, Separation Bubbles, Computational Fluid Dynamics, CFD, Coated Airfoils

EXPERIMENTS WITH THE REMUS AUV

Matthew D. Phaneuf-Lieutenant, United States Navy
B.S., University of South Carolina, 1997
Mechanical Engineer-June 2004
Master of Science in Mechanical Engineering-June 2004
Advisor: Anthony J. Healey, Department of Mechanical and Astronautical Engineering

This thesis centers on actual field operations and post-mission analysis of data acquired using a Remote Environmental Monitoring Unit (REMUS) Autonomous Underwater Vehicle (AUV) operated by the Naval Postgraduate School Center for Autonomous Underwater Vehicle Research. It was one of many platforms that were utilized for data collection during Autonomous Oceanographic Sampling Network II (AOSN II), an Office of Naval Research (ONR) sponsored exercise for dynamic oceanographic data taking and model based analysis using adaptive sampling. The vehicle's ability to collect oceanographic data consisting of conductivity, temperature, and salinity during this experiment is assessed and problem areas are investigated. Of particular interest are the temperature and salinity profiles measured from long transect runs of 18 kilometer length into the southern parts of Monterey Bay. Experimentation with the REMUS as a mine detection asset was also performed. The design and development of the mine hunting experiment is discussed, as well as results and analysis. Of particular interest in this portion of the work is the issue relating to repeatability and precision of contact localization, obtained from vehicle position and sidescan sonar measurements.
MECHANICAL ENGINEER

KEYWORDS: REMUS, AUV, Autonomous Underwater Vehicle, Mine Hunting, AOSN
WHAT IS THE ACADEMIC REVIEW PROCESS AND HOW IS IT WORKING AT THE NAVAL HOSPITAL CORPS SCHOOL?

Sonia I. Adams-Lieutenant, United States Navy
Master of Business Administration-June 2004

Timothy B. Worley-Lieutenant, United States Navy
Master of Business Administration-June 2004

Advisors: Alice Crawford, Graduate School of Business and Public Policy
Susan P. Hocevar, Graduate School of Business and Public Policy
CDR Phil J. Candreva, USN, Graduate School of Business and Public Policy

This thesis analyzes the Academic Review Process (ARP) at the Hospital Corps “A” School, specifically focusing on how it is working and the criteria of the Academic Review Board. This was accomplished by analyzing a data spreadsheet of students that went through the ARP in 2003 and administering a random survey to a general student sample and a sample of instructors in January 2004. The study identified and analyzed the perceptions of students, instructor staff, and headquarters staff in the evaluation of the ARP, analyzed a student data set by cross-referencing the recommendation and final disposition results of those that entered the ARP, and developed a cost framework for the command and future researchers to help determine the effectiveness of the process. The report includes recommendations for improving the ARP.


TWO ESSAYS IN APPLIED ECONOMICS: PAY-AS-YOU-GO AUTO INSURANCE AND PRIVATIZED MILITARY HOUSING

Keith T. Adkins-Lieutenant, United States Naval Reserve
Master of Business Administration-June 2004

Advisors: David R. Henderson, Graduate School of Business and Public Policy
Raymond E. Franck, Graduate School of Business and Public Policy

This MBA project applies economic principles to assess changes affecting the automobile insurance industry, Pay-as-You-Drive (PAYD) and Pay-at-the-Pump (PATP). These changes could affect DoD in the future. The project also applies economic principles to Basic Allowance for Housing (BAH) and the Military Housing Privatization Initiative (MHPI) currently affecting DoD. Each program is explained; then selected economic principles are applied that may influence decision-making of major stakeholders. Both PAYD and PATP automobile insurance provide consumers with the option to pay an amount for insurance directly related to actual miles driven. The shift from a fixed to a variable cost for automobile insurance creates an incentive for consumers to drive less, thus saving on the total cost of automobile insurance.

BAH and MHPI together represent a shift in how DoD calculates and pays for housing of military service members. Congress and DoD are challenged with rebuilding military housing after decades of neglect.

KEYWORDS: Pay-as-You-Drive, PAYD, Pay-at-the-Pump, PATP, Basic Allowance for Housing, BAH, Military Housing Privatization Initiative, MHPI, Military Housing
This study is part of a larger research project designed to establish the metrics and variables for the success of the NAVAIR Small Business Innovation Research (SBIR) program. The main objective of this study is to identify the factors that promote success of firms participating in the SBIR program.

The team developed a plan to gather the data and evaluate two categories of participants in the SBIR program, specifically, the stakeholders that reached Phase III and those firms that do not continue to Phase II or Phase III. The main source used to identify the firms as potential participants was NAVAIR’s SBIR program database. From this database, the team searched for potential interview participants, contacted the potential participants, and later conducted the interviews by phone.

A literature review was conducted for background and details on the essence of NAVAIR’s SBIR program. Variables that could influence entrepreneurial success were identified and a theoretical model of success was built. A qualitative analysis was used to gather data and the results were obtained using the thematic approach. By analyzing the data, the team examines the success of NAVAIR’s SBIR program from the perspective of the stakeholders and how they look at the different success criteria.

Finally, an analysis and results were generated based on the interviewees’ perceptions and responses. This report concluded with the factors influencing the success of the firms in the SBIR. From the findings, several recommendations were made for the SBIR program and future research.

**KEYWORDS:** Small Business Innovation Research Program, SBIR, Naval Air System Command, NAVAIR, Entrepreneurial Business Success, Culture, Military Business Success

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**INTERNATIONAL COOPERATIVE RESEARCH AND DEVELOPMENT BETWEEN THE UNITED STATES AND FRANCE, GERMANY, AND THE UNITED KINGDOM**

Orlando R. Aponte-Lieutenant Commander, Venezuelan Navy
Master of Business Administration-June 2004
Edward M. Cavins-Lieutenant, United States Navy
Master of Business Administration-June 2004
Georgios Ratsikas-Major, Hellenic Air Force
Master of Business Administration-June 2004

Advisors: David F. Matthews, Graduate School of Business and Public Policy
Raymond E. Franck, Graduate School of Business and Public Policy

With defense budgets shrinking throughout the world and coalition forces facing interoperability issues while conducting asymmetric warfare in a post Cold-War environment, many nations are seeking ways to acquire economical weapon systems that are interoperable with allies and coalition members. One method of addressing these concerns is International Cooperative Research and Development (ICR&D). This MBA project will evaluate the current ICR&D process and make recommendations to enhance the ICR&D process by examining ICR&D between the U.S. and NATO members, France, Germany, and the United Kingdom. Case studies were used for comparisons in order to determine the advantages and concerns pertaining to ICR&D and to recommend appropriate ICR&D strategies.

**KEYWORDS:** International Cooperative Research and Development, Defense Industrial Base, Multiple Launch Rocket System, Medium Extended Air Defense System, Joint Strike Fighter
A FINANCIAL ANALYSIS OF RETIREMENT PLAN INVESTMENT OPTIONS FOR MILITARY PERSONNEL
Albert Randall Baker-Lieutenant Commander, United States Navy
Master of Business Administration-June 2004
Advisors: Raymond E. Franck, Graduate School of Business and Public Policy
Nancy Roberts, Graduate School of Business and Public Policy

This project analyzes retirement investment options currently available to all U.S. service members. Specifically, it reviews eligibility requirements to participate in several investment vehicles, including military pensions, the Uniformed Services Thrift Savings Plan (TSP), traditional and Roth IRA’s, annuities and Certificates of Deposit (CD’s). Analysis of three notional service member profiles reveals the projected returns with retirement investment options. The information in this report is intended for discussion and initial planning purposes only. It is designed to help service members understand a general course of action that can help meet retirement objectives.

KEYWORDS: Financial Analysis, Retirement Planning, Investment Options

SOCIAL RESPONSIBILITY AS A MANAGEMENT CONTROL SYSTEM
Anthony A. Barger-Lieutenant Commander, United States Navy
Master of Business Administration-June 2004
William B. Zabicki, Jr.-Lieutenant Commander, United States Navy
Master of Business Administration-June 2004
Advisor: Mary Malina, Graduate School of Business and Public Policy
Second Reader: Nicholas Dew, Graduate School of Business and Public Policy

This thesis examines how businesses with social responsibility as part of their core strategy use related management control systems within Harvard Business School Professor Robert Simons’ business strategy control model. The model explains the interaction of four control levers (Beliefs Systems, Boundary Systems, Interactive Control Systems, and Diagnostic Control Systems) to balance business strategy. Researchers examine how management control systems for social responsibility apply to each control lever both in theory and through the application of case examples. Finally, the model from corporate America is overlayed onto the Naval Postgraduate School to examine where socially responsible management control systems operate to control and adjust the overall socially responsible business strategies.

KEYWORDS: Social Responsibility, Management Control Systems, Strategy, Performance Measures

ECONOMIC SECURITY ENVIRONMENT AND IMPLEMENTATION OF PLANNING, PROGRAMMING, BUDGETING, EXECUTION (PPBE) SYSTEM IN GEORGIA
Maia Chiabrishvili-Major, Georgian Army
Master of Business Administration-June 2004
Advisor: Raymond E. Franck, Graduate School of Business and Public Policy
Second Reader: Jerry L. McCaffery, Graduate School of Business and Public Policy

This thesis identifies and analyzes the main aspects and challenges faced by Georgia’s National Security after regaining independence. Economic security is the initial subject of analysis. The thesis examines the Ministry of Defense as a public sector agency; the problems in government institutions resulting from the old Soviet mentality, and the lack of leadership skills in a democratic society which led to Georgia’s political crisis and economic decline, a common problem in countries in transition; specifics about the distribution of financial power in an unstable economic environment decline and the negative effects of instability on defense reform processes, particularly in the implementation of the PPBE System.

The intent of this research is to explain the interrelationships of harmonious, sustainable growth and PPBE as an established system for transparency. The thesis provides a record and explanation of events that caused the current problems in defense planning and the budgeting process, as well as recommendations for future improvements to the PPBE system in the Georgian Armed Forces (GAF).
main focus is on policy formulation and budget execution; performance; accountability; fiscal discipline; and transparency. The conclusion summarizes the thesis, which presented the arguments for successful reform processes in the GAF, particularly in its medium-term budgeting cycle.

**KEYWORDS:** Georgia, State Budget, Georgian Armed Forces, GAF, Public Sector, Defense Policy, Defense Budget, PPBES, Medium-term Planning

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**INFLUENCES ON THE RETENTION OF RESIDENCY-TRAINED AND NON-RESIDENCY TRAINED NAVY DENTAL CORPS OFFICERS**

Alan B. Christian-Lieutenant, United States Naval Reserve  
Master of Business Administration-June 2004  
Advisors: Alice Crawford, Graduate School of Business and Public Policy  
William Gates, Graduate School of Business and Public Policy  
Kathryn Kocher, Graduate School of Business and Public Policy

This research project identifies key influences on the retention of Navy dental officers beyond their post-obligation period. Two sample groups were selected. The first sample group was selected from dental officers who did not receive a Navy sponsored residency program and the second group from dental officers who completed a Navy sponsored residency program. Logistic regression models were developed for the Non-Residency and Residency sample data obtained from Bureau of Medicine and Surgery Manpower Information System. The results revealed that accession source, dental specialty, and the number of operational tours as a percentage of total tours an officer completes during his or her obligation period were significant factors for retention of dental officers in the Non-Residency Model. Significant factors identified for the Residency Model were gender, age when first paid as a Navy Dentist, the number of years dental officers waited to begin a Navy-sponsored residency program, and dental specialty. Dental officers who receive their residency training between their sixth and eighth year of service are more likely to remain on active duty more than one year beyond their obligated service commitment than officers beginning residency programs earlier or later in their careers.

**KEYWORDS:** Retention, Navy Dental Corps Officers

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**ANALYSIS OF DISTRIBUTED DYNAMIC DECISION-MAKING (DDD) AND VIRTUAL DESIGN TEAM (VDT) SIMULATION TECHNIQUES TO DETERMINE FEASIBILITY OF USING VDT SIMULATION TO VALIDATE DDD MODELS**

Eugen Constantin-Major, Romanian Ministry of Defense  
Master of Business Administration-June 2004  
Nikolaos Papanagiotou-Major, Hellenic Air Force  
Master of Business Administration-June 2004  
Sanjeev Singh-Lieutenant, Indian Navy  
Master of Business Administration-June 2004  
Advisors: Susan P. Hocevar, Graduate School of Business and Public Policy  
David Kleinman, Department of Information Sciences  
Mark Nissen, Graduate School of Business and Public Policy

Today, military organizations are increasingly facing many asymmetric challenges requiring, among other capabilities, a high level of structural adaptation.

How can the structure be aligned with the mission to best achieve the planned objectives, while also dealing with highly uncertain scenarios and complex decisions of prioritization? What are the signals that may indicate the need for this adaptation?

Attempts to answer these questions have already been made (e.g., Entin, 1999; Hocevar, 2000; Hutchins, Hocevar, Kemple, Kleinman, Entin, and Serfaty, 2000; Levchuk, Merina, Levchuk, Pattipati, and Kleinman, 2001; Diedrich, Entin, Hutchins, Hocevar Rubineau, and MacMillan, 2003) and the results indicate that performance, in the cases where the structure and the mission are out of line, was characterized by increased communication, increased perceived workload, and degraded performance.
The goal of this work was twofold: using a computational model, Virtual Design Team (VDT), first researchers wanted to understand how decision makers’ behavior changes as a result of changes in organizational structure and mission context; and second, to validate the previous results of Adaptive Architectures for Command and Control (A2C2) experiments, proving that VDT can be a feasible alternative to empirical experimentation.

**KEYWORDS:** DDD, A2C2, VDT, Experiment 8, Organizational Behaviors, Simulation, Modeling, Functional Organizations, Divisional Organizations

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**THE VALUE OF LOGISTICS INFORMATION TO THE WARFIGHTER**

Christopher J. Corrigan-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2004  
Jayson E. Kielar-Lieutenant, United States Navy  
Master of Business Administration-June 2004  
Advisors: Nicholas Dew, Graduate School of Business and Public Policy  
David R. Henderson, Graduate School of Business and Public Policy

This MBA project analyzes the benefit of integrating Radio Frequency Identification (RFID) technology into the Department of Defense (DoD) supply chain management infrastructure. The project confirms the existence of an inherent value in logistics information used as a resource in DoD supply chain management applications. Also identified is the value of comprehensive and real time logistics information to the warfighter, and what he or she is willing to pay for that information. For example, the average value the warfighter is willing to pay on a deployed aircraft carrier is 2.46% of the carrier’s average annual budget, or $856,775. To determine these values, the project utilizes the results of a survey distributed to Naval Supply Corps Officers who were used as survey respondents due to their positioning as a logistics and financial choke-point between the man in the foxhole and his commanding officer. Using the value that supply officers are willing to pay for comprehensive and real time information, a value added figure is determined for the inclusion of RFID technology in the DoD supply chain management infrastructure. Continuing with the aircraft carrier example, the value added figure is $11.28 per requisition.

**KEYWORDS:** Radio Frequency Identification Device Technology, RFID Technology, Supply Chain Management, Logistics, Supply, In Transit Visibility, ITV, Budget

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**BUILDING LINE OFFICERS INTO FINANCIAL MANAGERS: AN ANALYSIS OF THE PROCESS AND RECOMMENDATIONS FOR IMPROVEMENT**

David C. Cutter-Commander, United States Navy  
Master of Business Administration-June 2004  
Advisors: John Mutty, Graduate School of Business and Public Policy  
Jerry L. McCaffery, Graduate School of Business and Public Policy

With a FY 2004 budget of $114 billion, there is no question that the Department of the Navy is involved in big business. If compared to the sales revenues of the Fortune 500, the Navy would rank sixth. After having weathered a prolonged drawdown through the 1990’s, Naval leadership must recapitalize its aging legacy systems. The plan to accomplish this task is the Sea Enterprise component of the Navy’s Sea Power 21 strategy. In order to reach these goals, the Chief of Naval Operations needs a cadre of business-savvy line officers who can properly allocate scarce resources. The core of this group is comprised of line officers who hold the Financial Management (FM) subspecialty designator. This thesis applies a managerial control system approach to the process of filling Financial Management billets with properly qualified FM line officers. Complex and multifaceted, the process contains three distinct components: promotion, assignment, and education. After examining levers of control that can be accessed by the FM community manager, this thesis identifies system weaknesses. Recommendations to solve the weaknesses include improved control and tailored incentives. The combination of control and incentives could improve the qualification rate of the Navy’s FM officer positions and, ultimately, allow the Navy to meet its Sea Enterprise goals.
The purpose of this project is to complete the first phase of a broader research project concerning the exploration of the relationship between consumer attitudes and demand for almonds. This thesis aims to provide a scientific methodology for assessing the effect promotional expenditures have on influencing consumer attitudes and the demand for almonds.

This project was conducted with the sponsorship of the Almond Board of California (ABC), an organization supervised by the United States Department of Agriculture, responsible for promoting the consumption and increasing the market share of California produced almonds in domestic and international markets.

The primary objective of the project is to develop a methodology that links research, public relations, and advertising expenditures made by the ABC, to Attitude, Awareness, and Usage (AAU) measurements and eventually to almond shipping and pricing data. The ABC is required by legislation to conduct a return on investment (ROI) analysis every five years. In conducting this analysis, the organization is interested in developing a management tool that can indicate ROI, but can also be used to identify the portfolio of investments that will maximize AAU (attitudes, awareness, usage). This would allow the ABC to assess the relative impact of its investment portfolio (promotional expenditures) and use this information to make the necessary adjustments in order to improve its effectiveness.

The purpose of this MBA project is to provide a comprehensive update of the Navy Contract Writing Guide. The project was conducted with the sponsorship and assistance of the Office of the Assistant Secretary of the Navy for Research, Development, and Acquisition. The Guide was updated in December 2003 in an effort to provide organization and clear and concise solutions to current contract issues. Extensive research, incorporating interviews, websites, and regulations, was utilized in updating this Guide. It has been reorganized to better reflect actual contract writing and to address issues and solutions that were not previously addressed within the Guide. This Guide will provide a comprehensive instruction on contract writing with invaluable information relating to the most common contract issue, problem disbursements.
MASTER OF BUSINESS ADMINISTRATION

IMPLEMENTING THE MISSION-FUNDED NAVAL SHIPYARD: A CASE STUDY ON CHANGE MANAGEMENT
Jed R. Espiritu-Lieutenant, United States Navy
Master of Business Administration-June 2004
Advisors: Nancy Roberts, Graduate School of Business and Public Policy
CDR Phil J. Candreva, USN, Graduate School of Business and Public Policy

This thesis seeks to determine how Naval shipyards could better implement mission funding after having worked extensively under a Working Capital Fund structure. Several principles exist in current management literature that can be applied to this funding source change at Naval shipyards. Of these principles, six recurring guidelines for successful change management and an organizational open-systems framework are used to provide guidelines for shipyard change managers.

The transition of the Puget Sound Naval Shipyard provided a case study for applying this managerial theory. The six guidelines of change management were found to have applications for the case study, revealing the need for a clear vision statement, a leadership core, communication on multiple levels, attention to change inertia, and rewards for change behavior during a transformation. Furthermore, six key factors for success at Puget Sound Naval Shipyard provided additional guidelines for future transitioning shipyards, promoting command-level attention to mission funding issues, making a commitment to best practices, developing a specific timetable of milestones, seeking alternative sources of funding, performing functional area assessments, and developing and employing desk procedures.

KEYWORDS: Mission Funding, Working Capital Funds, Naval Shipyards, Change Management, Organizational Theory

AN EXAMINATION OF THE UNITED STATES AIR FORCE PROPOSED LEASE OF REFUELING TANKERS
Daniel Lewis Furber-Major, United States Army
Master of Business Administration-June 2004
Harry Jaeger-Lieutenant Commander, United States Navy
Master of Business Administration-June 2004
Advisors: Joseph San Miguel, Graduate School of Business and Public Policy
John Shank, Graduate School of Business and Public Policy

This project analyzes the proposed United States Air Force “acquisition” of 100 KC-767A tankers to replace KC-135E Statotankers. The Air Force intended to use an operating lease to obtain the services of these KC-767As in a timely manner and begin recapitalization of the aging aerial refueling fleet. There are three major research questions driving this project. First, in terms of national security, mission, and readiness, is there an immediate need for the Air Force to replace the KC-135? Second, if there is a need to replace the KC-135, is the KC-767A the best aircraft to satisfy the Air Force’s long-term objectives? Finally, using the proposed lease of 100 aircraft, as the Air Force suggested, is leasing the best financial alternative to replace the KC-135? To answer these questions, an examination of the KC-135 history, history of the proposed lease, comparison of alternative aircraft and solutions, stakeholder analysis, comparison of operating and capital leases, cost analysis, acquisition process, and other issues are presented. The examination concludes that the Air Force’s proposed solution using the KC-767 aircraft and the operating lease method is not the best available.

KEY WORDS: KC-767, Tanker, Leasing, KC-135, KC-10, KC-X, Omega Air, Special Purpose Entity, Private Financing Initiative, Acquisition, Boeing, Refueling, Air Force
The purpose of this research is to provide guidance that will increase awareness and facilitate class discussions on ethical situations that contracting officers are exposed to during their business relationships with contracting firms. The cases explore the specifics of individual incidents of ethical and procedural procurement violations. Additionally, this study provides conclusions and recommendations that could better educate prospective contracting officers on the temptations and legal ramifications of violations of procurement fraud within their commands.

**KEYWORDS:** Class Decisions, Contracting Officers, Contracting Firms, Procurement Fraud

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This project analyzes the surplus ammunition disposal process in the Bulgarian Armed Forces. This thesis explains how the system works and considers whether it could better serve national security needs. The end of the Cold War and the ensuing doctrinal changes led to a significant reduction in most European countries’ armies. This led, in turn, to huge stockpiles of surplus ammunition, which pose threats to national security, to the environment, and to the defense budget. While some aspects of stockpile management and security do have political implications, the disposal process as a whole needs a detailed cost-benefit analysis. This project analyzes relevant data, takes existing constraints into consideration, and recommends possible technological and cost-reducing improvements.

**KEYWORDS:** Ammunition Disposal, Stockpile Management, Bulgarian Armed Forces, Utilization, Surplus Explosive Ordnance

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This study examines the Reserve Non-Prior Service Accession (NPS) program, the effects of the current training process on Reserve readiness, and the effects of various proposals for extending the active duty training period. In particular, the thesis examines the effects of the extended training programs on recruiting, using data derived from a web-based survey of NPS Reservists. Multivariate logistic regression models are used to examine the effects of personal demographic characteristics on an individual’s likelihood to enlist in the NPS program for a 28-day or 77-day active duty training period. Separate models are used for each program and include a model with the Delayed Entry Program (DEP) as an option, and a model without the DEP option. Respondents report that they would have been slightly less inclined to enlist under the 28-day options, whereas under the 77-day options, respondents indicated that they would have been much less inclined to enlist. A cost-effectiveness analysis is also conducted for both a 28-day and a 77-day training option. FY03 cost data is used to conduct the cost-effectiveness analysis, and indicates that the 28-day option would save an estimated $2.8 million and decrease NPS personnel training time by five months. The 77-day option would cost an estimated additional $46.1 million and decrease NPS personnel
training time by 21 months. Based on the analysis of this thesis, it is recommended that the current NPS accession program be phased out and the 77-day with DEP training alternative be implemented. Additionally, the recruiting focus should be shifted to target high school seniors and recent graduates.

KEYWORDS: Non-prior Service, Naval Reserve, Accessions, Recruiting, Training

ISLAMIC PUBLIC INFRASTRUCTURE FINANCING: AN ANALYSIS OF ALTERNATIVE FINANCING INSTRUMENTS WITH APPLICATION IN DEVELOPING COUNTRIES
Saiful Islam-Civilian, Indonesian Ministry of Finance
Master of Business Administration-June 2004
Advisors: Robert McNab, Defense Resources Management Institute
Carmelita Troy, Graduate School of Business and Public Policy

This thesis examines the structure of public infrastructure financing in Indonesia and whether financing based on Islamic principles is a feasible alternative to current financing mechanisms. The structure of public infrastructure investment can be determined by comparing the amount of public saving or domestic resources relative to foreign debt resources. Typically, public infrastructure investment flows consist of twenty to forty percent domestic investment and sixty to eighty percent foreign investment. This financing mixture, however, may lead to fiscal constraints when debt service occurs. If the investment funds are unproductive, then the infrastructure project may not generate sufficient revenue to offset debt service obligations. This problem is compounded in the presence of corruption, crime, and other forms of the absence of the rule of law. The funding constraint mitigates the dominant role of government and encourages private entities to provide and finance public infrastructure. Islamic project financing, through such vehicles as debt, hybrid, and equity instruments, may be able to respond to this challenge.

KEYWORDS: Public Infrastructure Financing, Islamic Finance

THE CURRENT STATUS OF THE UNITED STATES FOREIGN MILITARY SALES (FMS) PROGRAM
Najmuddin Jaafar-Lieutenant Colonel, Malaysian Army
Master of Business Administration-June 2004
Abdulmonem Alsabt R. Malallah-Major, Bahrain Defense Force
Master of Business Administration-June 2004
Mohamed A.R. Sharif-Major, Bahrain Defense Force
Master of Business Administration-June 2004
Advisors: John Mutty, Graduate School of Business and Public Policy
William Gates, Graduate School of Business and Public Policy

This research examines the status of the United States (U.S.) Foreign Military Sales (FMS) program within the context of the current ever-changing domestic and global security environment. Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was used to analyze: the information gathered from the literature review; the importance of various players (domestic and international competitors, interests groups, decision makers); and the general environment (global security and the economic environment that shape the National Security Strategy (NSS)). The study concludes that the U.S FMS program has evolved slowly because of the nature of the arms export business and the constraints imposed by the National Security Strategy. Recommendations for improving the FMS program are provided.

The defined benefit (DB) pension system which provides retirement security to 44.5 million Americans faces significant challenges. At the end of 2003, the system was underfunded by $350 billion, there were 82,696 fewer plans than during the system peak (in 1985), and the Pension Benefit Guaranty Corporation (PBGC) responsible for ensuring that retirees receive their retirement benefits even after a plan terminates reported a deficit of $11.49 billion. This thesis examines the challenges facing the DB pension plan system, beginning with an overview of the DB plan system, a review of the different plan types, the benefits received, and funding rules. Next, the thesis examines the PBGC, its purpose, organization, and the role that it plays in the DB pension system. The thesis includes an identification of the challenges facing the pension plan system and corporate America's frustrations with the system. Finally, the thesis presents some recent reform proposals and provides corporate America's response to those proposals. A changing workforce demanding leaner retirement options, plans that allow multiple career changes, provide beneficiaries with lump sum benefits, provide early vesting characteristics, and are easily understood, is challenging the future of the DB plan system. To survive, the DB plan system must continue to change.

KEYWORDS: Private Pension, Defined Benefit Pension, Retirement Planning

Determinate of Defense Budget Processes in Post-Communist Poland:
FROM THE WARSAW PACT TO THE 21ST CENTURY
Pawel Lepianka-Captain, Polish Air Forces
Master of Business Administration-June 2004
Advisor: Richard B. Doyle, Graduate School of Business and Public Policy
Second Reader: John Mutty, Graduate School of Business and Public Policy

This thesis identifies and explains the critical changes that have occurred in the complex system of interrelated rules which have governed the defense budget process in Poland since 1989. This research explains the legal and institutional evolution of the defense budget process in post-Communist Poland, focusing on the role of legislative authority, i.e., the Sejm and the Senat of the Republic of Poland, within the defense budget process since the collapse of the Warsaw Pact. It also analyzes the distribution of power among the different actors in the budget cycle. This is followed by a thorough description of rules imposed by the Law on Restructuring, Technical Modernization and Financing of the Polish Armed Forces in the Years 2001-2006, and the Act of Equipping the Armed Forces of the Republic of Poland with Multi-Role Aircraft. These two documents were instrumental in shaping defense spending in Poland in the years 2001-2003 and will have a great impact on future decisions concerning defense budgets in the years to come. An overview of defense spending by European members of NATO is also provided, to allow a comparison of Poland’s willingness to commit resources to the common defense of other NATO members.

KEYWORDS: Sejm, Poland, Defense Budget Process, Senat of the Republic of Poland, Defense Spending, NATO, Warsaw Pact
The purpose of this research is to provide guidance by which future U.S. Navy Contingency Contracting Officers (CCOs) can effectively prepare for contingency operations. Additional research will provide guidelines for sustainment to support major contingencies. The research for this study was accomplished by reading literature on the subject of contingency contracting. Further research encompassed gathering information on lessons learned from past contingency contracting operations.

Contingency contracting issues provided in this research project include an examination of preparatory steps required by Navy CCOs prior to deployment. Also included are sustainment issues that could positively affect a contingency operation and funding requirements that should be understood while conducting contingency operations. Additionally, this study provides conclusions and recommendations that could enhance the effectiveness of future Navy CCOs in support of contingency operations.

KEYWORDS: Contingency, Contracting

The primary objective of this project is to determine accurate and justifiable pricing for the foreign military sale of electronic technical manuals under the guiding principles of DoD Instruction 7000.14-R. DoD Instruction 7000.14-R, paragraph 0716, prescribes the methods that will be used to determine the price of DoD publications when they are sold to foreign military sales (FMS) customers. The Instruction includes publication pricing factors that shall be included in the development of FMS prices for paper publications. When technical data was maintained and distributed primarily by paper form, pricing the product to recover the associated costs was a relatively reasonable and reliable process. With the transition from paper to electronic data encompassed in various media and arrangements, the costs associated with this migration will differ considerably. As electronic storage and presentation of digital data becomes more interactive with the Internet, the association between the existing practices and advanced products become more contradictory. The historical pricing procedures will no longer reflect the costs that need to be recovered. In this era of digital data and computerized integration, new technological advances have increased the demand and cost of services associated with digitization of paper documents. With the introduction of these new technologies, various fees associated with this transformation have to be incorporated into the pricing structure that currently exists. The problem that exists with the incorporation of these fees is the lack of long-term historical data due to the relative infancy of the goods and services linked to this technology.

KEYWORDS: Foreign Military Sales, Commercial Pricing, Software Cost Analysis, Work Breakdown Structure, Pricing Policy
ASSESSMENT OF COSTS AND BENEFITS OF THE MILITARY HOUSING PRIVATIZATION IN SELECTED AREAS
Thongchai Punja-Commander, Royal Thai Navy
Master of Business Administration-June 2004
Gabor Kerek-Major, Hungarian Army
Master of Business Administration-June 2004
Advisor: Robert Looney, Department of National Security Affairs
Second Reader: Kevin Gue, Graduate School of Business and Public Policy

The Military Housing Privatization Initiative (MHPI) represents a dramatic revision in the construction and maintenance of military housing. The Basic Allowance for Housing (BAH) initiative is also a long waited major step towards providing an adequate quantity and quality of living quarters for service members and their families. This MBA project compares MHPI to the other two family housing programs, such as military construction (MILCON) and BAH, and analyzes the interrelationship among them. This project studied the examples of the Presidio of Monterey/NPS and the Hickam AFB housing privatization projects in detail.

The research concludes that MHPI is a valuable and flexible tool for bridging the gap between existing housing needs and what the Government has been able to provide through traditional military construction. Since many long-term uncertainties exist regarding DoD’s future housing needs and the resulting effect of the BAH initiative, this project recommends capitalizing on the strength of each housing tool (BAH, MHPI) through a more integrated approach to ensure that the military’s housing needs are met as efficiently as possible. A better coordination on housing initiatives appear to be important, since housing allowances could rise in some areas, thereby making more local housing affordable to service members and lessening the need for renovation and construction. Greater adherence to a policy of coordination is needed if DoD is to avoid building or revitalizing more housing than is needed under both military construction and privatization programs.

KEYWORDS: Military Housing Privatization Initiative, Basic Allowance for Housing, Military Family Housing

PROSPECTS FOR IMPROVING THE RESOURCE ALLOCATION PROCESS FOR NATIONAL SECURITY IN JAMAICA: A COMPARATIVE STUDY
Andrew F. Sewell-Major, Jamaica Defence Force
Master of Business Administration-June 2004
Advisors: Robert McNab, Defense Resources Management Institute
Peter Frederiksen, Defense Resources Management Institute

This thesis takes an in-depth look at the resource allocation process in Jamaica for the military. It comments on the trends observed over the period 1990-2003, and especially the declining purchasing power of the allocated funds when converted to US$. The budgeting processes used for the military in Canada, the U.K., and the U.S. is also examined. The purpose of this thesis is to establish whether or not the resource allocation in Jamaica is adequate and needs to remain as is or if there is a need for it to be changed. The study finds that while all four nations enjoyed democratically elected leadership in-terms of government, they have different outlooks on the provision of resources for national security. The study further finds that where there is no clear difference between the executive arm of government and the legislative, resource allocation seems more controlled by the constraints model of problem solving. As such, it is not typically the imminent security problem that is funded, but rather funding is provided relative to the previous year’s allocation. The understanding of best practices in the field of national security is important, since history shows that foreign trade, and hence economic prosperity, are more likely to be associated with nations that create secure environments. How much to allocate to defense and the consideration of all other viable alternatives is crucial. Stability is critical to the prosperity of countries with emerging economies, like Jamaica, and as such, only an inclusive approach by key elements in the society can best decide how much resources should be allocated for national security.

KEYWORDS: Jamaica, Budgeting, Resource Allocation, Decision Making
ANALYSIS OF TRUST IN INTEGRATED PRODUCT TEAMS (IPT) IN THE MARINE CORPS
ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV) PROGRAM

Boris Slodička-Lieutenant Colonel, Slovak Army
Master of Business Administration-June 2004
Ioannis Delimitros-Major, Hellenic Army
Master of Business Administration-June 2004

Advisors: Roxanne V. Zolin, Graduate School of Business and Public Policy
George Thomas, Graduate School of Business and Public Policy

Few studies have focused on the analysis of trust within an IPT team where military and civilian subcultures coexist. The purpose of this MBA project is to provide an analysis of trust in the Advanced Amphibious Assault Vehicle (AAAV) program. The primary objectives of this project are to identify significant relationships between trust of military and civilian personnel and to identify relationships between geographic workplace setting and trust of military and civilian personnel. The ultimate goal for the study is to provide recommendations for increasing the trust level among team members, and in this way to enhance the acquisition process. Data are processed and analyzed using descriptive statistics, t-tests for differences in means before and after collocation and military versus civilian personnel, Pearson correlation coefficients, linear regression, and Chow’s test.

The analysis reveals significant differences between trust of military personnel and civilian personnel before collocation. No significant differences in trust between military and civilian personnel after collocation are found.

Also, it is found that there is a difference between trust of military team members before and after collocation of the working teams.

The study results show that formal policies and procedures are a significant predictor of trust for military personnel before collocation, but not after collocation. Further research could focus on inspecting the relationships between trust of military personnel, formalism, and geographic workplace settings.

KEYWORDS: Trust, Advanced Amphibious Assault Vehicle Program, AAAV Program, Military or Civilian Backgrounds, Analysis of Trust

MARKETING PLAN FOR THE NAVAL POSTGRADUATE SCHOOL MASTER OF BUSINESS ADMINISTRATION TO THE NAVY UNRESTRICTED LINE COMMUNITY

R. Luis Trevino-Lieutenant Commander, United States Navy
Master of Business Administration-June 2004
Issares Lertangtam-Lieutenant, Royal Thai Navy
Master of Business Administration-June 2004
Nick Viera-Lieutenant, United States Navy
Master of Business Administration-June 2004

Advisors: Becky Jones, Graduate School of Business and Public Policy
Doug Moses, Graduate School of Business and Public Policy

The purpose of this Master of Business Administration (MBA) project is to develop a practical marketing plan to attract U.S. Navy Unrestricted Line (URL) officers to the resident Naval Postgraduate School Defense-focused MBA (NPS-MBA). The intent of this project is to create awareness in the Navy URL community about the benefits of the Defense-focused MBA and to build a brand name for NPS-MBA. The goal is to make the resident NPS-MBA the graduate business school product of choice. The authors believe that the MBA degree provides URL officers the business tools required to become successful managers in the modern Naval establishment.

The origin of this project was to conduct a present situation analysis of the NPS-MBA degree by determining its strengths, weaknesses, opportunities, and threats. It was noted that there is a decreasing number of URL officers in the NPS-MBA program since its inception in January 2002. Although graduate education is a strategic goal for Navy officers, this study finds that current URL career progression does not provide an adequate time for resident graduate education. In addition, a fleet survey conducted in a fleet concentrated area in San Diego, California, in March of 2004, revealed URL officers’ awareness and
attitudes toward NPS-MBA. This information enables the authors to arrive at effective marketing strategies and recommendations.

**KEYWORDS:** Marketing Plan, MBA, MBA Professional Report, Marketing Plan for Defense-focused MBA, Marketing Plan to URL Community

**ANALYSIS OF SEPARATION PAY OPTIONS**  
**Damian K. Viltz-Lieutenant, United States Navy**  
**Master of Business Administration-June 2004**  
**Advisors: William Gates, Graduate School of Business and Public Policy**  
**John Mutty, Graduate School of Business and Public Policy**

As the demand for and supply of skills in the Navy changes, the Navy needs the flexibility to shape the force as appropriate. This flexibility may include the need to reduce the number of personnel in some subspecialties. The question the Navy faces is how to shape the force in the most efficient means possible. This project analyzes the costs and benefits of various options for voluntarily separating members from the Navy. Drawing on recent market design research, it tests alternative force shaping policies and recommends a mechanism that can increase force shaping flexibility and efficiency.

**KEYWORDS:** Separation Pay, Drawdown, VSI, SSB, TERA
MASTER OF SCIENCE

Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Technology Management
Leadership and Human Resource Development
Management
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Operations Research
Physical Oceanography
Physics
Program Management
Software Engineering
Space Systems Operations
Systems Engineering
Systems Technology
High-resolution combat simulations that model urban combat currently use computationally expensive algorithms to represent urban target acquisition at the entity level. While this may be suitable for small-scale urban combat scenarios, simulation run time can become unacceptably long for larger scenarios. Consequently, there is a need for models that can lend insight into target acquisition in urban terrain for large-scale scenarios in an acceptable length of time.

This research develops urban target acquisition models that can be substituted for existing physics-based or computationally expensive combat simulation algorithms, and result in faster simulation run time with an acceptable loss of aggregate simulation accuracy. Specifically, this research explores: 1) the adaptability of probability of line of sight estimates to urban terrain; 2) how cumulative distribution functions can be used to model the outcomes when a set of sensors is employed against a set of targets; 3) uses for Markov Chains and Event Graphs to model the transition of a target among acquisition states; and 4) how a system of differential equations may be used to model the aggregate flow of targets from one acquisition state to another.

KEYWORDS: Probability of Line of Sight, Line of Sight, Urban Target Acquisition, Cumulative Distribution Functions, Markov Chains, Systems of Differential Equations
CONSTRUCTION AND TESTING OF COMPACT LOW-NOISE HYDROPHONES WITH EXTENDED FREQUENCY RESPONSE  
Konstantinos Bakas-Lieutenant, Hellenic Navy  
B.S., Hellenic Naval Academy, 1994  
Master of Science in Applied Physics-June 2004  
Advisors: Thomas Hofler, Department of Physics  
Bruce Denardo, Department of Physics  

A simple low-noise hydrophone design with internal preamplifier is presented. This design is similar to published designs and is a variation of the design developed by former NPS student Miguel Alvarado [2003], except that several improvements are included. These improvements include a simplification of the structure and its modes of vibration, a large reduction in package diameter and the effect its acoustic diffraction has on the sensitivity and an extended upper frequency response of 42 kHz resulting from the simplified structure and reduced diameter. Furthermore, the modified geometry along with its orientation in the water should produce a very omni-directional response in the horizontal plane at the higher frequencies. Finally, a new feedback preamplifier design developed by Hofler and Alvarado is discovered to have some subtle but serious performance problems. These problems are resolved in this research and the resulting preamplifier performance is tested and documented herein.  

KEYWORDS: Hydrophone, Sound Receiver, Transducer, Low Noise Preamplifier  

DESIGN OF A BORE SIGHT CAMERA FOR THE LINEATE IMAGE NEAR ULTRAVIOLET SPECTROMETER (LINUS)  
Rodrigo Cabezas-Lieutenant, Chilean Navy  
B.S., Chilean Naval Polytechnic Academy, 1996  
Master of Science in Applied Physics-June 2004  
Advisors: Richard Harkins, Department of Physics  
D. Scott Davis, Department of Physics  

The Lineate Image Near Ultraviolet Spectrometer (LINUS) is a spectral imager that works in the ultraviolet region of the spectrum. This thesis describes the latest of several steps in the development of this instrument. Due to the narrow field of view of the instrument, 2.5 x 0.5 degrees, an accurate pointing method is necessary; also, a scheme of quality evaluation of the post-processed spectral image is desirable. A way to achieve both goals is developed by designing and implementing the layout for two visual cameras, wide and narrow field of view, and a method to capture the images in order to perform the subsequent comparison with the processed spectral image. Since this is the first time the system is working in full-automated mode, a new wavelength calibration with the emission lines from a platinum hollow cathode lamp is performed and a new response curve for sulfur dioxide (SO$_2$) is taken. Finally, laboratory and outdoor field observations are conducted to test the system integration.  

KEYWORDS: Sensors, Spectral Imaging, Spectrometer, Remote Sensing
A recent improvement to the Seaweb underwater wireless network was the implementation of a Selective Automatic Repeat Request (SRQ) mechanism. SRQ is a protocol implemented in the Seaweb link layer as a measure for mitigating unreliability inherent in the telesonar physical layer. In January 2004, an experiment was performed in St. Andrew’s Bay, Panama City, Florida. The goal was to transmit large data files through the network, in accordance with a Naval Special Warfare need for imagery file telemetry. For three point-to-point test geometries, SRQ was tested with a noisy and variable physical layer. Through the incorporation of SRQ, the unreliability was overcome. A link-budget model, calibrated with the sound channel data collected from the experiment, establishes the benefit of a “SRQ gain.”

KEYWORDS: SRQ, Link-budget, Acoustic Communications, FORCEnet, Link Layer, Telemetry, ARQ, Telesonar, Seaweb

Orthogonal frequency-division multiplexing (OFDM) systems have experienced increased attention in recent years and have found applications in a number of diverse areas, including telephone-line based Asymmetric Digital Subscriber Line (ADSL) links, digital audio and video broadcasting systems, and wireless local area networks (WLAN). OFDM is a powerful technique for high data-rate transmission over fading channels. However, to deploy OFDM in a WLAN environment, precise frequency synchronization must be maintained and complicated frequency offsets must be handled. In this thesis, various techniques to improve the data throughput of OFDM WLAN are investigated. A simulation tool is developed in MATLAB to evaluate the performance of the IEEE 802.11a physical layer. A rapid time and frequency synchronization algorithm using only the short training sequence of the IEEE 802.11a standard is proposed, thus reducing the training overhead by 50%. Particular attention is paid to channel coding, block interleaving, and antenna diversity. Computer simulation shows that drastic improvement in error rate performance is achievable when these techniques are deployed.

KEYWORDS: OFDM, WLAN, IEEE 802.11a, Exponential Channel Model, Packet Detection, Frame Synchronization, Frequency Synchronization, Carrier Offset, Phase Noise, Pilot Phase Tracking, Channel Estimation, Equalization, Scrambling, Convolutional Coding, Interleaving, Maximal Ratio Combining, Selection Diversity, Viterbi Algorithm, Soft Decision Decoding, Puncturing
DIRTY BOMBS: THE TECHNICAL ASPECTS OF RADIOLOGICAL DISPERSION DEVICES

Benjamin F. Visger-Ensign, United States Navy
B.S., United States Naval Academy, 2003
Master of Science in Applied Physics-June 2004
Advisor: Xavier Maruyama, Department of Physics
Second Reader: Russell Coile, Sand City Police Department

Considering the ever-rising threat of terrorist attack and disruption of the economy and of daily activity, the potential strength of a radiological dispersion device must be evaluated. A “dirty bomb” is a weapon in the terrorist arsenal that is highly effective in creating chaos, panic, and disruption. All of the immediate deaths caused by a “dirty bomb” are due to blast effects; however, the public association with radiation and nuclear devices is one of fear and hyperbole. The individuals and agencies that respond to this type of event will have the greatest impact on the general public. By looking at case studies and potential scenarios or exercises, the first responder can appreciate the nature of radiation as well as its impact on response. This paper provides first responders with basic information on nuclear physics and exposes relevant issues in responding to a radiological dispersion device. An understandable link between nuclear physics and radiation response does exist.

KEYWORDS: Dirty Bomb, Radiological Dispersion Device, First Responder, Radiation, Weapons of Mass Destruction

THE ELECTROMAGNETIC RAILGUN AND THE FREE ELECTRON LASER

Robert E. Williams-Lieutenant, United States Navy
B.S., Auburn University, 1999
Master of Science in Applied Physics-June 2004
Advisor: William B. Colson, Department of Physics
Second Reader: Robert L. Armstead, Department of Physics

In this thesis, theory and simulations of the railgun and free electron laser (FEL) are presented, as well as a suggestion for extending the railgun lifecycle. The theory, design, and analysis of an electromagnetic railgun using a numerical model are discussed. The effects of varying electrical pulse formations, rail materials, and geometries are explored. The application of a metallurgical process to mitigate hypervelocity gouging in railgun rails is proposed. This concept, to delay the onset velocity of gouging by laser peening rails surfaces, may significantly increase the velocity at which projectiles acceptably traverse the barrel and extend the useful life of rails. If successful, this process would apply to any pair of materials in sliding contact at high relative velocity, including rocket sled tracks and light gas guns barrels. The status of proof-of-concept tests at Lawrence Livermore National Laboratory (LLNL), University of California, Davis (UC Davis), and University of Texas at Austin (UT) is covered. FEL simulations investigating the effect of electron beam focal point variations on the optical mode within the undulator are also presented.

KEYWORDS: Free Electron Laser, Short Rayleigh Length, Optical Mode, Railgun, Directed Energy, Simulation, Gouging, Hypervelocity Gouging

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QUANTIFYING SLEEP AND PERFORMANCE OF WEST POINT CADETS: A BASELINE STUDY
Aileen Kenney-Ensign, United States Naval Reserve
B.S., United States Naval Academy, 2003
Master of Science in Applied Science (Operations Research)-June 2004
Daniel Neverosky-Ensign, United States Naval Reserve
B.S., United States Naval Academy, 2003
Master of Science in Applied Science (Operations Research)-June 2004
Advisor: Nita Lewis Miller, Department of Operations Research
Second Reader: Lyn R. Whitaker, Department of Operations Research

This study reports the initial findings of a four-year longitudinal study undertaken to assess the total amount of sleep received by cadets at the United States Military Academy. Specifically, data on the Class of 2007 are collected and analyzed during the freshman year. Survey data are collected (n=1290) on sleep habits prior to the cadets reporting to the Academy. Actigraphy data are collected (n=80) during summer military training and during the Fall academic semester. Survey data are analyzed using two different methods to determine total amount of sleep prior to reporting to the Academy (\(\bar{x} = 8.5\) hrs, s.d. = 1.7 hrs; \(\bar{x} = 7.76\) hrs, s.d. = 1.46 hrs). Actigraphy data reveal that cadets receive much less nighttime sleep (naps not included) during the Fall academic semester than they report receiving in the 30 days before Cadet Basic Training (CBT) (total: \(\bar{x} = 5.32\) hrs, s.d. = 35.3 mins; school nights: \(\bar{x} = 4.86\) hrs, s.d. = 37.4 mins; non-school nights: \(\bar{x} = 6.56\) hrs, s.d. = 64.4 mins). Using morningness-eveningness chronotypes, owls and non-owls differed significantly along the following dimensions: cadet attrition (z=2.66, p=0.0039), fall term academic quality point average (t=3.92, p<0.001), military program score (t=5.169, p<0.001), and physical program score (t=3.295, p=0.001). Suggestions for additional analysis of existing and subsequent data are proposed.

KEYWORDS: Sleep Deprivation, Adolescents, College, Fatigue, Performance, Military, Student, Alertness, Learning, Memory, Morningness, Evenningness

ANTI-SUBMARINE WARFARE FUSION ON A PERSONAL COMPUTER
Joelle J. Mann-Ensign, United States Navy
B.S., United States Naval Academy, 2003
Master of Science in Applied Science (Operations Research)-June 2004
Advisor: Alan Washburn, Department of Operations Research
Second Reader: Roger Bacon, Chair of Undersea Warfare

LosCon, the software program developed for the author’s thesis and tested at sea, is designed to help the ASW commander regain tactical control in a loss of submarine contact situation. Persistent detection and cueing in the battlespace depend on utilizing contact reports from a network of combatant platform and offboard sensors. LosCon, an extended Kalman filter-based program modeled after MTST (Maneuvering Target Statistical Tracker), can integrate the sensor network very efficiently. Kalman filtering is a method of recursively updating the position of an evading target and accuracy of the target’s position using imperfect measurements. Lines of bearing to the contact with associated standard deviation bearing errors and positions with their standard deviation range errors are the measurements LosCon uses to generate an ellipse of the submarine’s likely position or AOU (Area Of Uncertainty). LosCon will also generate an expanded AOU for any future time, allowing commanders to correctly estimate the size of the search area. The effectiveness of the sea shield concept depends on the ability of organic forces to deny the enemy
tactical control of the battlespace area. Incorporating the information generated by LosCon would assist ASW commanders in maintaining undersea superiority.

**KEYWORDS:** Kalman Filtering, Anti-submarine Warfare, Lost Contact

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**THE EFFECTS OF REVERSING SLEEP-WAKE CYCLES ON MOOD STATES, SLEEP, AND FATIGUE ON THE CREW OF THE USS JOHN C. STENNIS**

Tiffoney L. Sawyer-Ensign, United States Navy  
B.S., Old Dominion University, 2003  
Master of Science in Applied Science (Operations Research)-June 2004  
Advisor: Nita Lewis Miller, Department of Operations Research  
Second Reader: LCDR Laura A. Barton, USN, Department of Operations Research

This study investigates the effects of reversing sleep-wake cycles on mood, sleep, and fatigue of the crewmembers and Air Wing 9 of the **USS JOHN C. STENNIS** (CVN-74). It also reviews the research conducted in sleep deprivation, circadian rhythms, shiftwork, fatigue, and mood. The effects of reversing sleep-wake cycle on mood of the crewmembers are analyzed by assessing a repeated administration of the Profile of Mood States (POMS). Mood states are monitored at three time points associated with the current work schedule (night shift vs. day shift) of the crewmembers. Results show that younger participants are angrier than older participants on night shiftwork. The results also indicate a significant interaction between repeated measures of mood states and gender. In addition, female participants reported significantly higher mood scale scores than the male participants, and topside participants get significantly less sleep than belowdecks participants. Given these findings, this area of research warrants further exploration. There is a significant need to educate military personnel of the effects of sleep deprivation and shiftwork on their job performance and individual health and safety. In this thesis, two lossless compression approaches are presented.

**KEYWORDS:** Profile of Mood States, POMS, Sleep Deprivation, Fatigue, Circadian Rhythm, Melatonin, Shiftwork, Combat Duty

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**THE COMPLEX FREQUENCY RESPONSE, IMPULSE RESPONSE, AND TRANSFER FUNCTION OF AN OCEAN WAVEGUIDE**

Walter B. Schulte, III-Ensign, United States Navy  
B.S., University of California-Los Angeles, 2003  
Master of Science in Applied Science (Signal Processing)-June 2004  
Advisor: Lawrence J. Ziomek, Department of Electrical and Computer Engineering  
Second Reader: Roberto Cristi, Department of Electrical and Computer Engineering

In this thesis, the ocean is modeled as a waveguide with an ideal pressure-release surface, and an ideal rigid bottom. The ocean waveguide is then treated as a linear, time-invariant, space-variant (TISV) filter or communication channel. The filter is time-invariant because no motion is modeled and because the properties of the ocean are assumed to be constant. The filter is space-variant because of the presence of the two boundaries, that is, the ocean surface and ocean bottom.

This thesis investigates the ocean as a linear TISV filter by evaluating: 1) the complex frequency response, 2) the impulse response, and 3) the transfer function of the ocean with respect to depth. It is shown that the TISV impulse response of the ocean contains information that can be used to help localize a target in range and whether the target is above or below the receiver. Computer simulation results are obtained by evaluating the three filter functions for several different test cases.

**KEYWORDS:** Anti-submarine Warfare, Ideal Pressure-release Surface, Rigid Bottom Ocean Waveguide Model, Linear, Time-invariant, Space-variant Filters, Complex Frequency Response, Impulse Response, and Transfer Function of the Ocean, Target Localization
The Navy is considering the use of unmanned surface vehicles (USVs) to reduce risk to personnel in maritime interdiction operations and to conduct intelligence, surveillance, and reconnaissance (ISR) and force protection (FP) missions. In this thesis, alternative configurations of the prototype and operational uses of the USV are explored using agent-based simulation for three scenarios. An efficient experiment design alters settings of ten factors for the two ISR scenarios and 11 factors for the FP scenario. Some factors varied in the experiment are uncontrollable during operations, such as the total number of contacts, threat density, their maneuvering characteristics, and the sea state. The USV sensor range and endurance are also considered, as well as factors set by the decision maker for a particular mission: namely, USV speed and numbers to deploy. The results provide several operational and tactical insights with implications for patrolling and combat radius, and form the basis for a recommendation to use the USV in an active role in maritime missions. The results also support the guidance on the benefits of improving USV sensing and endurance capabilities, and find that simply increasing USV numbers is not necessary for attaining high mission performance.

**KEYWORDS:** Agent-based Simulation, Design of Experiments, Unmanned Surface Vehicles, USV, PYTHAGORAS, Multiple Linear Regression, Regression Trees, Information, Surveillance and Reconnaissance, ISR, Force Protection, FP
DEVELOPMENT OF A HIGH-PRECISION SENSOR FOR THE ATTITUDE DETERMINATION OF THE BIFOCAL SPACECRAFT SIMULATOR

Brian D. Connolly-Lieutenant, United States Navy
B.A., University of Montana, 1993
Master of Science in Astronautical Engineering-June 2004
Advisors: Brij Agrawal, Department of Mechanical and Astronautical Engineering and Space Systems Academic Group
Marcello Romano, Department of Mechanical and Astronautical Engineering and Space Systems Academic Group

The Bifocal Relay Mirror table is a second-generation, hemispherical, air-bearing satellite testbed under development in the Spacecraft Research and Design Center of the Naval Postgraduate School. The objective of this testbed is to provide on-the-ground simulation of the dynamics and control of spacecraft for high precision acquisition, tracking, and pointing applications associated with space-based laser relay. The required initial attitude determination accuracy for the Bifocal Relay Mirror test bed is 10 µ-radians. Normally, in laboratories where very high initial attitude knowledge is required, actual (space qualified) star trackers are incorporated into the testbed design. This is not possible at NPS as the laboratory does not have a skylight to allow visual access to the stars, and the photosensitive nature of many of the experiments would make such an opening inconvenient. Since it is critical to the operation of the testbed to provide accurate attitude knowledge, a substitute system is required.

The present thesis documents the development of a new attitude sensor capable of providing attitude information within the required 10µ-radians (within a field of view of the order of 1 deg). The concepts leading up to the final design, the testing and selection of the equipment used in the final configuration, and a detailed explanation of how the final system calibration is performed are discussed in detail.

KEYWORDS: Star Tracker, Testbed, Laser Alignment, Attitude Determination
Network Address Translation (NAT) for Internet Protocol Version Four (IPv4) was developed primarily to curb overcrowding of the Internet due to dwindling global IP addresses; however, NAT provides several other benefits. NAT can be used to mask the internal IP addresses of an Intranet. IPv6, the emerging standard for Internet addressing, provides three times the number of bits for IP addressing. While IPv6 does not need NAT for connectivity, other NAT features such as address hiding are valuable. There is currently no NAT implementation for IPv6.

The focus of this research was the design and development of a NAT implementation for IPv6. This implementation will be used within a multilevel testbed. In addition, the NAT implementation developed here can facilitate the Department of Defense (DoD) transition to IPv6, planned for 2008, by providing services currently not available for IPv6.

A working implementation of NAT for IPv6 within the Linux kernel has been produced. The NAT development created here has been tested for support of the protocols of Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Internet Control Message Protocol (ICMP) for IPv6.

KEYWORDS: Network Address Translation, NAT, IPv6, IPv4, MYSEA, MLS, Common Criteria, Linux Source Code, Netfilter, Iptables

CYBERCIEGE SCENARIO ILLUSTRATING SECRECY ISSUES THROUGH MANDATORY AND DISCRETIONARY ACCESS CONTROL POLICIES IN A MULTI-LEVEL SECURITY NETWORK

User training in computer and network security is crucial to the survival of modern networks, yet the methods employed to train users often seem ineffective. One possible reason is that users are not fully engaged during these training sessions and thus they tend to forget the lessons being taught.

The CyberCIEGE game introduces a new method of training in computer and network security. The player engages in a simulation-based network security game that reflects real-world security principles. Each time the CyberCIEGE game runs, it loads a Scenario Definition File (SDF) written to teach specific security concepts.

This thesis developed such a scenario definition file for the CyberCIEGE game. The educational purpose of the scenario is to illustrate secrecy issues in the context of mandatory and discretionary access control in a multilevel networked environment. The primary work of this thesis is to construct the scenario definition file such that playing the resulting game achieves this educational purpose.
This thesis also constructs scenario definition files to test the CyberCIEGE game engine for expected results. These tests provide support for several recommendations for improvement in the game engine.

**KEYWORDS:** Information Assurance, CyberCIEGE, Scenario Definition File, Network Security Training

**EXPLORING A CHROMAKEYED AUGMENTED VIRTUAL ENVIRONMENT FOR VIABILITY AS AN EMBEDDED TRAINING SYSTEM FOR MILITARY HELICOPTERS**

Mark J. Lennerton-Captain, United States Marine Corps  
B.S., Keene State College, 1990  
Master of Science in Computer Science-June 2004  
Advisor: Rudolph P. Darken, Department of Computer Science  
Second Reader: CDR Joseph Sullivan, USN, Department of Computer Science

Once the military helicopter pilot deploys aboard a Naval vessel, all training platforms, short of the actual aircraft, that present enough fidelity to maintain the highest levels of readiness are left behind. This thesis takes a preliminary step in creating a trainer that places the pilot in an immersive and familiar environment to exercise myriad piloting tasks as faithfully and as rigorously as in actual flight. The focus of this thesis is to assess the viability of a chromakeyed augmented virtual environment (ChrAVE) trainer embedded in a helicopter for use in maintaining certain perishable skills. Specifically, this thesis addresses the task of helicopter low-level land navigation. The ChrAVE is developed to substantiate the viability of having embedded trainers in helicopters. The ChrAVE is comprised of commercial-off-the-shelf (COTS) equipment on a transportable cart. In determining whether a system such as the ChrAVE is viable as a laboratory for continued training in a virtual environment, the opinion of actual pilots that are tasked with realistic workloads is used. Additionally, empirical data is collected and evaluated according to the subject pool’s thresholds for acceptable low-level navigation performance.

**KEYWORDS:** Virtual Environments, Terrain Association, Navigation, Embedded Trainers, Chromakey, Augmented Reality, Mixed Reality, Helicopter, Mission Rehearsal, Route Rehearsal, Spatial Orientation, Motion Tracked, Human-computer Interface

**SUITABILITY OF THE SRC-6E RECONFIGURABLE COMPUTING SYSTEM FOR GENERATING FALSE RADAR IMAGES**

Kendrick R. Macklin-Lieutenant, United States Navy  
B.S., San Diego State University, 1997  
Master of Science in Computer Science-June 2004  
Advisor: Neil Rowe, Department of Computer Science  
Second Reader: Douglas J. Fouts, Department of Electrical and Computer Engineering

This thesis evaluates the usefulness of the SRC-6E reconfigurable computing system for a radar signal processing application and documents the process of creating and importing very high speed integrated circuit hardware description language (VHDL) code to configure the user definable logic on the SRC-6E. The research builds on previous work which implemented a false radar imaging algorithm on the SRC-6E. Data from alternative computational approaches to the same problem are compared to determine the effectiveness of SRC-6E solution. The results show that the SRC-6E provides and effective solution for implementations with greater than 64 range bins. An evaluation of the SRC-6E difficulty of use is conducted, including a discussion of required skills, experience, and development times. The algorithm test code is included in the appendices.

**KEYWORDS:** Benchmark, Reconfigurable Computing, VHDL, SRC-6E, FPGA, False Radar Target Synthesis
A CYBERCIEGE SCENARIO ILLUSTRATING MULTI-LEVEL SECRECY ISSUES IN AN AIR OPERATIONS CENTER ENVIRONMENT
Marc K. Meyer-Captain, United States Air Force
B.S., Norwich University, 1999
Master of Science in Computer Science-June 2004
Advisors: Cynthia Irvine, Department of Computer Science
Paul Clark, Department of Computer Science
Second Reader: Michael Thompson, Department of Computer Science

CyberCIEGE provides an addition to traditional Information Assurance (IA) education in the form of an interactive, entertaining, commercial-grade, PC-based computer game. Educational sessions are contained in scenarios that serve to teach particular IA concepts. The details of a scenario are contained in a Scenario Definition File (SDF), which is written in the CyberCIEGE Scenario Definition Language. This language is rich enough to express a range of information security policies and operational data access requirements, resulting in a near limitless pool of possible scenarios.

This thesis develops a playable scenario illustrating confidentiality protection concepts in an open storage environment modeled after an Air Operations Center. Educational goals include physical protection of high value assets and use of strong authentication policies to protect moderate value assets. The major work of this thesis is design of an SDF to reflect a military information security policy and work flow environment contained in the educational goals. The confirmation of the proper operation of selected aspects of the CyberCIEGE game engine, and the assurance that the SDF confronts the player with the security trade-offs, occur through the application of a testing methodology. The creation of detailed solutions and examples of incorrect gameplay choices facilitate this testing.

KEYWORDS: CyberCIEGE, Information Assurance, IA, Scenario Definition File, SDF

SECURE REMOTE NETWORK ADMINISTRATION AND POWER MANAGEMENT
Mark P. Sullivan-Captain, United States Air Force
B.S., University of Maryland University College, 2000
Master of Science in Computer Science-June 2004
Advisor: Dale Courtney, Department of Information Sciences
Second Reader: Dennis Volpano, Department of Computer Science

Remote Network Administration allows network administrators to manage their networks while being physically separated from the network equipment. Having the capability to manage wired and wireless networks securely, from remote locations, can substantially reduce operating expenses across the entire Department of Defense. A variety of methods for remotely managing networks is explored for both wired and wireless networks. Requirements for remote network administration are identified. Chief among them is security and the ability to remotely manage power. Several widely-used remote management utilities are examined. All fail to meet these two requirements. A new power control device is presented that can be managed securely and remotely.

KEYWORDS: Remote Network Administration, Network Management, Power Management

EFFECTIVE USE OF JAVA DATA OBJECTS IN DEVELOPING DATABASE APPLICATIONS.
ADVANTAGES AND DISADVANTAGES
Paschalis Zilidis-Major, Hellenic Air Force
B.S., Hellenic Air Force Academy, 1988
Master of Science in Computer Science-June 2004
Advisor: Thomas Otani, Department of Computer Science
Second Reader: Arijit Das, Department of Computer Science

Currently, the most common approach in developing database applications is to use an object-oriented language for the front end module, and a relational database for the back end datastore. The major
disadvantage of this approach is the well-known “impedance mismatch,” in which some form of mapping is required to connect the objects in the front end and the relational tuples in the back end.

Java Data Objects (JDO) technology is recently proposed Java applications program interface (API) that eliminates the impedance mismatch. By using JDO API, the programmers deal strictly with objects. JDO hides the details of the backend datastore by providing the object-oriented view of the datastore. JDO automatically handles the mapping between the objects and the underlying data in the relational database, which is hidden from the programmer.

This thesis investigates the effectiveness of JDO. Part of the analysis develops a database application using JDO. Although JDO provides the benefits of object-orientation in design and implementation of the databases, it is not immune to problems and limitations. The thesis also analyzes the advantages and disadvantages of using JDO and discusses the areas requiring improvements in future releases.

**KEYWORDS:** Datostore, Java Data Objects, JDO, API, Java
In the ongoing attempt to deliver quality goods and services in less time and cost to the government, the concept of “Best Value” contracting has been explored. One element of best value contracting is to consider factors along with price in the source selection process to achieve a perceived best value to the government. Past performance measurement and its use in best value procurements has been practiced since the early 1990s.

This thesis explores the past performance guidance within DoD in its use as a source selection factor. Automated tools for tracking past performance are examined as well as their effectiveness and problems associated with data collection and use. Several steps must occur prior to past performance playing the role that was envisioned in order to include it as a factor combined with price in the source selection process.

So that past performance data can be used more effectively, this thesis recommends that contracting personnel and contractors establish a process that standardizes the method of measurement, automates its collection, and allows for viewing across the spectrum of past performance data. Furthermore, past performance data should be used within a risk management framework that assesses a contractor’s capability risk to perform on the current procurement.

**KEYWORDS:** TERMS Past Performance, Best Value, Performance Risk Analysis Group, PRAG, Past Performance Information Management System, PPIMS
A “Bold Case for Unconventional Warfare” argues for the establishment of a new branch of service with the sole responsibility of conducting Unconventional Warfare (UW). The thesis statement is: Unconventional warfare is a viable tool for achieving national security objectives under certain circumstances. The first hypothesis states that in order for UW to be effective it must be managed in accordance with specific principles. The second hypothesis states that to optimize UW, a new branch of service under the Department of Defense is required. Chapter II establishes the strategic requirement, laying the foundation by explaining the differences between UW and conventional warfare. Chapter III explains the requirements for dealing with sub-state conflicts. Chapter IV articulates the operational construct for UW revolving around an indigenous-based force in order for the U.S. to gain influence in a targeted population.

The second half of this thesis, Chapters V-VI, analyzes policy, doctrine, and schooling, as well as case studies of United States Army Special Forces (USSF) efforts in the Vietnam War and El Salvador, in order to reveal a conventional military aversion to the use of UW. The conceptual discussion of Chapters I thru IV, supported by the research of Chapters V and VI, together make “A Bold Case for UW.”

KEYWORDS: United States Army Special Forces, Civilian Irregular Defense Program-Vietnam, Counter Insurgency-El Salvador, Support to Insurgency, Sub-state conflict, Unconventional Warfare Principles, Preconditions, Model, Construct, Branch of Service
A key finding is that NCW, which also takes into consideration the impact of other strategic factors discussed in this thesis, has the potential to achieve many of the objectives currently “floating” in existing military transformation strategies.

KEYWORDS: Network Centric Warfare, Transformation, Strategy, Low-intensity conflicts, Military Doctrine and Organization

HISTORICAL ANALYSIS OF THE BATTLE OF LITTLE BIGHORN UTILIZING THE JOINT CONFLICT AND TACTICAL SIMULATION (JCATS)

Michael A. Charlebois-Major, United States Army
B.S., Sam Houston State University, 1991
Master of Science in Defense Analysis-June 2004

Keith E. Pecha-Major, United States Army
B.S., Wichita State University, 1991
Master of Science in Defense Analysis-June 2004

Advisors: Gordon McCormick, Department of Defense Analysis
Bard Mansager, Department of Applied Mathematics

The purpose of this thesis is to determine which of three competing theories of outcomes for the Battle of Little Bighorn is the most plausible by utilizing the Joint Conflict and Tactical Simulation (JCATS) program developed by Lawrence Livermore National Laboratory. There are many practical benefits that JCATS can provide today’s military with regard to training and educating soldiers for future conflicts. JCATS can be used to train soldiers in planning and executing missions in ways not feasible during conventional field training exercises with live bodies and real vehicles. JCATS is also increasingly used for actual mission planning. However, very little has been done using JCATS to war-game past operations.

There are two points to be gained by using JCATS to model a historical battle such as the Battle of Little Bighorn. First, it validates the ability of JCATS to accurately model actual historical scenarios, while identifying many of the specific limitations of the program. If the military is going to use computer simulations such as JCATS in lieu of field training exercises to train soldiers, it must first be determined if the program produces realistic results. Modeling an actual battle and comparing the results of the program with what actually occurred is one means of doing so. Second, modeling historical battles, particularly defeats, may assist in discovering lessons learned. In a field training exercise, a defeated force can be brought back to life and given another opportunity to apply the lessons learned from its previous defeat. Real battles afford no such opportunity. Computer modeling of past battles allows military planners to isolate individual events and decisions and study their impact on the outcome.

KEYWORDS: High Resolution Modeling, After Action Review with High Resolution Combat Modeling, AAR, Simulation, Modeling

PERSONNEL RECOVERY OPERATIONS FOR SPECIAL OPERATIONS FORCES IN URBAN ENVIRONMENTS: MODELING SUCCESSFUL OVERT AND CLANDESTINE METHODS OF RECOVERY

Marshall V. Ecklund-Major, United States Army
B.S., United States Military Academy, 1992
Master of Science in Defense Analysis-June 2004

Michael A. McNerney-Major, United States Air Force
B.S., United States Air Force Academy, 1990
Master of Science in Defense Analysis-June 2004

Advisor: David Tucker, Department of Defense Analysis
Second Reader: Hy S. Rothstein, Department of Defense Analysis

This thesis presents two prescriptive models for approaching challenges to special operations forces with regard to personnel recovery in an urban environment. This thesis begins by developing a model for overt recovery methods, using McRaven’s Model of Special Operations as the foundation. This model is then tested against three different case studies from operations in Mogadishu, Somalia, in 1993. The original six
principles proposed by McRaven are complimented with four newly-prescribed principles that account for the interactions of the isolated personnel. Following this analysis, a nonconventional assisted recovery model is presented for clandestine personnel recovery methods. This model borrows the relative superiority concept from McRaven’s theory, but proposes six different principles. This model is evaluated using three case studies ranging from the World War II era through Operation Iraqi Freedom. These cases support the idea that while the urban operational environment may vary across time and space, the principles supporting successful personnel recovery operations endure.


WHO NETWORKS? THE SOCIAL PSYCHOLOGY OF VIRTUAL COMMUNITIES
James B. Kinniburgh-Captain, United States Air Force
B.A., University of Oklahoma, 1996
Master of Science in Defense Analysis-June 2004
Advisor: Dorothy Denning, Department of Defense Analysis
Second Reader: John Arquilla, Department of Defense Analysis

Special Operations Forces (SOF) members must be fully capable (fluent and adept) at operating in, through, and upon networks to maximize the leverage of information technologies. Military information operators must possess the components of network capital (access to technology, computer literacy, and fluency with social networking), a strong tendency to engage in trusting behavior, high cognitive ability, and a formal education. Virtual communities offer a mosaic of social behaviors and practices that provide models for virtual organization(s) within the military. Computer-mediated communications technologies (CMCTs) provide an inherently neutral but polymorphic forum for human social interaction (cyberspace). Specific emergent social topology (real or virtual) depends on the local social needs of individuals and/or bounded groups (communities). Because differences in topology are emergent, topological models have little predictive value. Virtual communities are better understood and predicted through analysis of their metadata. Virtual communities can be characterized as open or clandestine, according to their purpose, accessibility, level of trust, and primary mode of connectedness (bonding or bridging ties). Both open and clandestine communities offer methods of ensuring high levels of efficiency, trust, and security within military computer-mediated communications networks, as well as providing models of organizational flexibility that can be adapted to SOF missions and roles.

KEYWORDS: Computers, Networks, Virtual Communities, Sociology, Cybersociology, Netwar, Information Operations, Information Warfare, Psychology, Society, Intelligence, Special Operations, Communications

THE TAO OF SPECIAL FORCES: AN ANALYSIS OF COUNTERINSURGENCY DOCTRINE
D. Todd Reed, Jr.-Major, United States Army
B.B.A., Middle Tennessee State University, 1992
Master of Science in Defense Analysis-June 2004
Adrian A. Donahoe-Major, United States Army
B.S., University of South Dakota, 1993
Master of Science in Defense Analysis-June 2004
Advisor: Kalev Sepp, Department of Defense Analysis
Second Reader: John Arquilla, Department of Defense Analysis

This thesis presents a prescriptive model for approaching challenges to counterinsurgencies. It begins by analyzing current doctrine and academic research on the subject of counterinsurgency. It then develops a model for a comprehensive counterinsurgency strategy using McCormick’s mystic diamond model of insurgent dynamics as the foundation. This model is then tested against five different case studies,
including three successes, one failure, and one incomplete application. Following test case analyses are recommendations for a new force structure, as well as applications for current operations in Iraq, Afghanistan, and the War on Terror. These cases support the idea that a successful counterinsurgency strategy must be comprehensive and include counter-resource, counter-organization, counter-infrastructure, and counterforce elements, while using psychological and information warfare to compound the results as well as gain the support and trust of the population.

**KEYWORDS:** Counterinsurgency, Insurgency, Unconventional Warfare, Information Warfare, COIN
Direct-Sequence Spread-Spectrum (DS-SS) is among the preferred modulation techniques for military applications. DS-SS offers three greatly desired characteristics: it allows for the development of Low Probability of Detection (LPD) and Low Probability of Intercept (LPI) systems and has a very good performance in fading channels. This thesis investigates the performance of the "Cross-Product RV (CRV) decomposition" as the basis of blind-equalization algorithms. The CRV is a rank-revealing decomposition alternative to the Eigenvalue Decomposition (EVD) that can provide a recursively updated estimate of the signal and noise subspace at a reduced computational cost. The CRV updating algorithm is implemented in MATLAB and evaluated in a previously proposed communication scheme intended for use in an underwater acoustic network called Seaweb. The underwater channel is modeled with the Monterey-Miami Parabolic Equation Model (MMPE) for various multipath perturbations. The receiver performance is examined using a Monte Carlo simulation. Bit-error rates versus signal-to-noise ratio are presented for various noise assumptions as well as receiver synchronization assumptions.

**KEYWORDS:** Underwater Acoustic Communications, Seaweb, Reverberation, TL, Ambient Noise, Interface Roughness, Internal Waves, Turbulence, Volume Perturbations, Sound Speed Perturbations, Doppler, MMPE, Direct Sequence Spread-spectrum, Gold-codes, CRV Decomposition, Subspace Decomposition, Blind Equalization, Matched Filter

Boost phase interception of ballistic missiles is envisioned as the primary response of the layered defense architecture implemented in the ballistic missile defense system. A limited time frame in which to take action and the necessity to implement hit-to-kill technology in the kill vehicle counterbalances the many advantages of boost phase interception. Direct-hit missile technology is constrained by the requirement to minimize miss distance to a negligible amount between the kill vehicle and optimum aimpoint on the target. This thesis examines kill vehicle effectiveness, which is tantamount to miss distance, as a function of both the kill vehicle maximum acceleration capability and the guidance system time constant necessary to destroy a target. The kill vehicle guidance system is modeled in MATLAB as a fifth order binomial series with proportional navigation. The simulation examines the effect of an accelerating target attributed to powered flight and aimpoint displacement caused by a shift in tracking point from the target plume to the payload when resolution occurs. The kill vehicle minimum requirements, as indicated by the simulation, include a lateral acceleration capability of four times the target acceleration and a guidance system time constant that is less than one-tenth the estimated flight time.
ELECTRICAL ENGINEERING


HARDWARE-IN-THE-LOOP CONTROL OF A CASCADED MULTI-LEVEL CONVERTER

Jacob L. Barlow-Ensign, United States Navy
B.S., North Carolina State University, 2003
Master of Science in Electrical Engineering-June 2004
Advisor: Robert W. Ashton, Department of Electrical and Computer Engineering
Second Reader: Roberto Cristi, Department of Electrical and Computer Engineering

Next-generation U.S. Navy destroyers, known as DD(X), will use electric drive motors to meet their propulsion needs instead of the traditional mechanical drives. The use of electric drive motors in naval vessels has spurred the development of high power converters. This thesis examines the feasibility of using an advanced control algorithm known as Sine-triangle Pulse Width Modulation (SPWM) in combination with a Cascaded Multi-Level Converter (CMLC) in order to meet the U.S. Navy’s strict requirements. The SPWM control algorithm is designed in Simulink and experimentally tested on a CMLC previously constructed at the Naval Postgraduate School. The controller and converter successfully power a quarter horsepower three-phase induction motor.

KEYWORDS: DC-AC, Multi-level, Cascaded Multi-level, Converter, Inverter, Sine-triangle, Space Vector Modulation, dSPACE, IPS, DD(X)

ADVANCED THERMOPHOTOVOLTAIC CELLS MODELING, OPTIMIZED FOR USE IN RADIOISOТОPE THERMOELECTRIC GENERATORS (RTGS) FOR MARS AND DEEP SPACE MISSIONS

Bradley P. Davenport-Ensign, United States Navy
B.S., United States Naval Academy, 2003
Master of Science in Electrical Engineering-June 2004
Advisor: Sherif Michael, Department of Electrical and Computer Engineering
Second Reader: Gamani Karunasiri, Department of Physics

Thermophotovoltaic (TPV) cells are a good candidate for use in high efficiency radioisotope thermoelectric generator (RTG) power devices for deep space missions. This thesis examines the use of Silvaco Virtual Wafer Fabrication Software as a tool for designing and optimizing TPV cells for different possible spectrums. Results are presented for gallium antimonide (GaSb) and indium gallium arsenide (InGaAs) cells optimized to the AM0 spectrum. These results closely match published data as well as hypothetical cells optimized to the spectrum of a 1300 K blackbody.

KEYWORDS: Thermophotovoltaic Cell, Radioisotope Thermoelectric Generator, Optimization, Model, Silvaco, GaSb, InGaAs

IMPROVED METHOD FOR SIMULATING TOTAL RADIATION DOSE EFFECTS ON SINGLE AND COMPOSITE OPERATIONAL AMPLIFIERS USING PSPICE

David M. Dufour-Lieutenant, United States Navy
B.S., Chapman University, 1995
Master of Science in Electrical Engineering-June 2004
Advisor: Sherif Michael, Department of Electrical and Computer Engineering
Second Reader: Andrew A. Parker, Department of Electrical and Computer Engineering

This research is part of a continued effort to simulate the effects of total dose radiation on the performance of single and composite operational amplifiers using PSPICE, circuit simulation software. This research provides further verification that the composite operational amplifier has a superior performance to the single operational amplifier while operating in a radiation flux. In this experiment, a single and composite op amp are constructed in PSPICE and implemented in a finite gain amplifier circuit. The effects of
ionizing radiation are simulated by varying the parameters of the components that made up the op amps. These component parameters are varied in ways that mimic the response of the actual components that were irradiated in previous research. The simulations are incrementally run to simulate an increasing radiation dose. The results of these simulations are then compared with the results of an actual study conducted at the Naval Postgraduate School, where similar circuits were irradiated using the school’s linear accelerator, LINAC. This procedure proves to be an improved method for predicting the effects of total dose radiation for radiation hardened devices, and provides additional confirmation of the superior performance of the composite op amp over the single op amp.

**KEYWORDS:** Total Dose Radiation, Single Operational Amplifier, Composite Operational Amplifier, Simulated Radiation Dose

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**CHARGE TRANSPORT STUDY OF INGAAS QWIPS**

Vu D. Hoang-DoD Civilian  
B.S., University of Nevada-Reno, 1989  
Master of Science in Electrical Engineering-June 2004  
Advisors: Nancy Haegel, Department of Physics  
John Powers, Department of Electrical and Computer Engineering

A series of experiments are performed to characterize the material properties of InGaAs/GaAs for use in a two-color quantum-well IR photodetector (QWIP) design. Results from room temperature studies using cathodoluminescence and photoluminescence indicate light emission at 858 nm and 1019 nm from GaAs and InGaAs, respectively. Using a direct transport imaging technique, an edge dislocation pattern is observed as confined to the InGaAs layer of the material. A dislocation density measurement is performed and is less than 2000 lines/cm. Quantitative intensity level measurements indicate fluctuation in the region of dislocations to be less than 30% of the signal to background level. Finally, a spot mode study using the direct transport imaging method is performed to evaluate the feasibility of using this technique for contactless diffusion length measurements.

**KEYWORDS:** IR Detectors, Two-color QWIPs, Cathodoluminescence, InGaAs/GaAs, Direct Transport Imaging, Contact-less Diffusion Measurements

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**INFRARED FACE RECOGNITION**  
Colin K. Lee-Lieutenant, United States Naval Reserve  
B.S., Naval Postgraduate School, 2004  
Master of Science in Electrical Engineering-June 2004  
Advisors: Monique Fargues, Department of Electrical and Computer Engineering  
Gamani Karunasiri, Department of Physics

This study continues a previous face recognition investigation using uncooled infrared technology. The database developed in an earlier study is further expanded to include 50 volunteers with 30 facial images from each subject. The automatic image reduction method reduces the pixel size of each image from 160 x 120 to 60 x 45. The study reexamines two linear classification methods: the Principal Component Analysis (PCA) and Fisher Linear Discriminant Analysis (LDA). Both PCA and LDA apply eigenvectors and eigenvalues concepts. In addition, the Singular Value Decomposition based Snapshot method is applied to decrease the computational load. The K-fold Cross Validation is applied to estimate classification performances. Results indicate that the best PCA-based method (using all eigenvectors) produces an average classification performance equal to 79.22%. Incorporated with PCA for dimension reduction, the LDA-based method achieves 94.58% accuracy in average classification performance. Additional testing on unfocused images produces no significant impact on the overall classification performance. Overall results again confirm uncooled IR imaging can be used to identify individual subjects in a constrained indoor environment.

**KEYWORDS:** Uncooled Infrared Imaging, Face Recognition, Principle Component Analysis, Fisher Linear Discriminant Analysis, SVD Decomposition, Cross Validation
REAL-TIME DATA ACQUISITION AND PROCESSING OF THE MAGNETIC, ANGULAR RATE AND GRAVITY (MARG) SENSOR

Ioannis R. Saliaris-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1996
Master of Science in Electrical Engineering-June 2004
Master of Science in Systems Engineering-June 2004
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

This research involves the development of a human-body motion tracking system constructed with the use of commercial off-the-shelf (COTS) components. The problem to be solved is that the data from the motion tracking sensors must be transmitted wirelessly in real time from a microcontroller to a server computer. Due to the fact that the microcontroller does not support a standard operating system (OS), widely used Personal Computer Memory Card International Association (PCMCIA) cards or Universal Serial Bus (USB) wireless modules cannot be used. The wireless communication module chosen for this purpose is the DPAC Technologies’ Airborne wireless module, a highly integrated 802.11b module that can be easily integrated with the microcontroller.

The evaluation of the module is completed in four stages. The first part is to initiate communication with the DPAC module. The second part is to establish communication between the DPAC module and a TCP server. The third part is to establish communication between the microcontroller and the DPAC module. The fourth part is to increase the baud-rate to the desired high value of 230,400 bps.

The evaluation result indicates that the DPAC Airborne wireless 802.11b module meets the wireless communication requirements of the motion tracking system.

KEYWORDS: MARG III Sensor, Control Interface Unit, CIU, Microcontroller, RS232, UART, PCMCIA, USB, Wireless Communication, 802.11, 802.11b, WiSER 2400, DPAC Airborne

ADVANCED TECHNIQUES TO IMPROVE THE PERFORMANCE OF OFDM WIRELESS LAN

Michail Segkos-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1994
Master of Science in Electrical Engineering-June 2004
Master of Science in Applied Physics-June 2004
Advisors: Tri T. Ha, Department of Electrical and Computer Engineering
Brett H. Borden, Department of Physics

Orthogonal frequency-division multiplexing (OFDM) systems have experienced increased attention in recent years and have found applications in a number of diverse areas, including telephone-line based Asymmetric Digital Subscriber Line (ADSL) links, digital audio and video broadcasting systems, and wireless local area networks (WLAN). OFDM is a powerful technique for high data-rate transmission over fading channels. However, to deploy OFDM in a WLAN environment, precise frequency synchronization must be maintained and complicated frequency offsets must be handled. In this thesis, various techniques to improve the data throughput of OFDM WLAN are investigated. A simulation tool is developed in MATLAB to evaluate the performance of the IEEE 802.11a physical layer. A rapid time and frequency synchronization algorithm using only the short training sequence of the IEEE 802.11a standard is proposed, thus reducing the training overhead by 50%. Particular attention is paid to channel coding, block interleaving, and antenna diversity. Computer simulation shows that drastic improvement in error rate performance is achievable when these techniques are deployed.

KEYWORDS: OFDM, WLAN, IEEE 802.11a, Exponential Channel Model, Packet Detection, Frame Synchronization, Frequency Synchronization, Carrier Offset, Phase Noise, Pilot Phase Tracking, Channel Estimation, Equalization, Scrambling, Convolutional Coding, Interleaving, Maximal Ratio Combining, Selection Diversity, Viterbi Algorithm, Soft Decision Decoding, Puncturing
AN INVESTIGATION OF A MULTIPLE-INPUT-MULTIPLE-OUTPUT COMMUNICATION SYSTEM WITH THE ALAMOUTI SPACE-TIME CODE
Michael J. Turpin-Lieutenant Commander, Canadian Navy
B.S., University of Ottawa, 1984
Master of Science in Electrical Engineering-June 2004
Advisor: Frank Kragh, Department of Electrical and Computer Engineering
Second Reader: R. Clark Robertson, Department of Electrical and Computer Engineering

This thesis investigates the fundamentals of multiple–input–multiple–output (MIMO) radio communication systems with space–time codes. A MIMO system is designed using the Alamouti space–time code. The modulation technique is binary phase-shift keying (BPSK). MATLAB with Simulink is used to simulate the design, which is tested in both an additive white Gaussian noise (AWGN) channel and in a multipath fading channel with AWGN. Theoretical performance is derived for both channels and compared to simulated results. The original receiver design is changed to incorporate a maximal-ratio combiner (MRC) receiving technique with channel state information (CSI). The theoretical performance for this design is determined and compared to simulated and published results.

KEYWORDS: Multiple Input Multiple Output, Alamouti Scheme, Space-time Coding, Binary Phase-shift Keying, Rayleigh Fading Channel, Multipath Fading Channel, Maximal Ratio Combining, Spectral Efficiency, Channel Capacity, MIMO, BPSK, MRC

A THREE-PHASE HYBRID INVERTER SYSTEM UTILIZING HYSTERESIS CONTROL
Terence H. White-Major, United States Marine Corps
B.S., University of California-Los Angeles, 1991
Master of Science in Electrical Engineering-June 2004
Advisor: Robert W. Ashton, Department of Electrical and Computer Engineering
Second Reader: Xiaoping Yun, Department of Electrical and Computer Engineering

Naval vessels of the future will require lighter, more compact, and more versatile power electronics systems. With the advent of the DC Zonal Electrical Distribution System, more innovative approaches to the conversion of the DC bus power to AC power for motor drives will enhance the efficiency and warfighting capability of tomorrow’s ships. This thesis explores the concept of a hybrid DC-AC power converter that combines a hysteresis controlled inverter with a six-step bulk inverter. A six-step bulk inverter is built from discrete components and tested in simulation and hardware. The two inverters are connected in parallel to provide a high-fidelity current source for a three-phase load. The addition of the hysteresis inverter to the bulk inverter adds a closed current loop for more robust control and improves the quality of the output load current.

KEYWORDS: Hybrid Inverter, Hysteresis Control, Inverter, Parallel Inverters, Six-step Inverter, Shipboard Motor Drives
MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

DIRECT-SEQUENCE SPREAD-SPECTRUM ACOUSTIC COMMUNICATIONS WITH CRV DECOMPOSITION
Pavlos Angelopoulos-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1994
Master of Science in Electrical Engineering-June 2004
Master of Science in Engineering Acoustics-June 2004
Advisors: Roberto Cristi, Department of Electrical and Computer Engineering
Kevin B. Smith, Department of Physics

Direct-Sequence Spread-Spectrum (DS-SS) is among the preferred modulation techniques for military applications. DS-SS offers three greatly desired characteristics: it allows for the development of Low Probability of Detection (LPD) and Low Probability of Intercept (LPI) systems and has a very good performance in fading channels. This thesis investigates the performance of the “Cross-Product RV (CRV) decomposition” as the basis of blind-equalization algorithms. The CRV is a rank-revealing decomposition alternative to the Eigenvalue Decomposition (EVD) that can provide a recursively updated estimate of the signal and noise subspace at a reduced computational cost. The CRV updating algorithm is implemented in MATLAB and evaluated in a previously proposed communication scheme intended for use in an underwater acoustic network called Seaweb. The underwater channel is modeled with the Monterey-Miami Parabolic Equation Model (MMPE) for various multipath perturbations. The receiver performance is examined using a Monte Carlo simulation. Bit-error rates versus signal-to-noise ratio are presented for various noise assumptions as well as receiver synchronization assumptions.


PREDICTING THE EFFECTS OF SEA SURFACE SCATTER ON BROAD BAND PULSE PROPAGATION WITH AN OCEAN ACOUSTIC PARABOLIC EQUATION MODEL
Richard M. Ead-DoD Civilian
B.S., University of Rhode Island, 1981
Master of Science in Engineering Acoustics-June 2004
Advisor: Kevin B. Smith, Department of Physics
Second Reader: Daniel T. Nagle, Naval Undersea Warfare Center-Newport Division

Littoral waters, when compared to the open ocean, create an environment of greater reverberation with acoustic energy scattering from the sea surface, bottom, topographic features, and regions that lack homogeneity within the volume. If the ocean surface is rough on the scale of an acoustic wavelength, considerable scattering can occur that can significantly influence coherent propagation. Because the rough surface is also evolving dynamically, such scattering can introduce Doppler shifting and spreading of the acoustic pulse spectrum. This thesis builds upon prior efforts in ocean acoustic modeling and focuses on examining surface scattering and its affect upon coherent propagation. The dynamics/physics associated with surface scattering are explored in detail and mathematical relationships are developed and employed in revisions to the Monterey Miami Parabolic Equation (MMPE) model. The thesis provides background information associated with the MMPE and highlights earlier work related to surface scattering. It presents a formal analysis of an exact surface scattering approach in the context of a continuous wave (CW) benchmark exercise and the Doppler shifts associated with a dynamic rough surface. It expands on prior rough sea surface work to include modeling based on an empirical fetch-limited ocean wave spectrum and compares modeling results with measured data. Interest in broadband pulse propagation in shallow water is
increasing with the need for improved active sonar systems and with the growth of applications such as underwater acoustic communications.

**KEYWORDS:** Sea Surface Scatter, Parabolic Equation Model, Doppler Scatter, Bragg Scatter, JONSWAP Spectrum

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**IMPROVING THE PERFORMANCE OF MINICAN LOW NOISE HYDROPHONE**

Mario Magliocchetti-Lieutenant, Chilean Navy  
B.S., Chilean Naval Polytechnic Academy, 1996  
Master of Science in Engineering Acoustics-June 2004  
Advisors: Thomas Hofler, Department of Physics  
Bruce Denardo, Department of Physics

The MiniCan hydrophone is a small, easy to build, preamplified hydrophone with similar characteristics in sensitivity and self noise to larger and more expensive commercial devices. Previous work on the design shows a very promising performance, though it proves to have a flat sensitivity response of only up to 14 kHz. Also unknown are the effects that the aluminum housing parts produce on the overall response and whether the cable of the hydrophone has some influence on the sensitivity. A new design is built and tested, changing the dimensions of the aluminum housing for the hydrophone, resulting in an increase in the region of flat sensitivity response up to 20 kHz and acceptable response up to 30 kHz, due to an increase of the lowest mechanical resonance of the hydrophone. A resonance testing device is built to investigate the mechanical characteristic of the components of the design, discovering that the first resonance of the aluminum base of 34.6 kHz caused the first overall resonance of the assembled device. Measurements of the influence of the cable show an acoustic variation of about 1 dB in relative response in the range of interest up to 30 kHz. The measurements prove that better performance can be achieved on the basic MiniCan design by increasing the resonant frequency of the aluminum body housing component.

**KEYWORDS:** Hydrophone, Sound Receiver, Transducer
The radio channel places fundamental limitations on the performance of mobile ad hoc wireless networks. In the mobile radio environment, fading due to multipath delay spread impairs received signals. This thesis develops a radio channel model and examines the effect of various parameters on channel behavior that is representative of environments where mobile ad hoc wireless networks operate. The various physical phenomena considered are outdoor environments, fading and multipath propagation, type of terrains, and mobility (Doppler shift). A channel model based on a Tapped Delay Line (TDL) structure is developed and implemented in the MATLAB programming language, and the performance of the time-varying channel is studied by plotting the signal constellations. Simulation results indicate that the number of taps required in the TDL is 8 or less and the carrier frequency does not influence the performance significantly. The Jakes Doppler spectrum should be used in urban environments with high mobility; the Gaussian Doppler spectrum is the choice for low mobility urban environments and for hilly terrain under both low and high mobility.

KEYWORDS: Wireless Network, Channel Model, Tapped Delay Line, Jakes Doppler Spectrum, Gaussian Doppler Spectrum
PUBLIC KEY INFRASTRUCTURE (PKI) was created to provide the basic services of confidentiality, authenticity, integrity, and non-repudiation for sensitive information that may traverse public (untrusted) networks. This thesis provides a brief description of the background and functional components of a PKI, and then ‘builds’ a PKI to be used for research at the Naval Postgraduate School (NPS). Deficiencies of this PKI with respect to DoD PKI policy are delineated. The thesis addresses details of software selection, installation, configuration and operation using Netscape’s Certificate Management System as its Certificate Authority application of choice. The functionality of this PKI is validated by testing all major certificate life-cycle events (creation, archival, revocation, validation, etc.) All but two of these tests, key escrow and revocation checking, are successful, and thus these two remain to be addressed by further work to make the NPS PKI fully functional.

KEYWORDS: Public Key Infrastructure, PKI, Certificate Authority

THE TACTICAL NETWORK OPERATIONS COMMUNICATION COORDINATOR IN MOBILE UAV NETWORKS

Warfare planners and tacticians are seeking ways to leverage information technology to gain advantage on the battlefield. With the advent of Internet technologies, complex systems are becoming more networked, and access to information is more critical than ever. The increasing utilization of special operations forces in ad hoc, dynamic operations poses a need for adaptable communications to support the unit. Effective communication within the unit and critical information exchange with the command center affect the overall outcome of the mission. An adaptive, mobile network with Unmanned Aerial Vehicles (UAV) relays is well-suited to support the ad hoc nature of special operations. The area of research for this thesis is the role of the tactical network operations communication coordinator in mobile UAV networks. The coordinator’s purpose is to oversee the management and status of the network and provide feedback to network participants, thus resulting in an effective and well-functioning environment. The tactical network coordinator establishes network awareness and so is an important and integral part of network operations. This thesis builds a model for sharing network awareness, and explores the potential benefits of incorporating network performance as a planning objective rather than a constraint.

KEYWORDS: Mobile Networks, Network Management, UAV, Special Operations Forces, Network Awareness
INFORMATION TECHNOLOGY MANAGEMENT

AN ANALYSIS OF THE EFFECT OF COMMISSIONING SOURCES ON RETENTION AND PROMOTION OF U.S. ARMY OFFICERS
Zafer Kizilkaya-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1999
Master of Science in Operations Research-June 2004
Master of Science in Information Technology Management-June 2004
Advisors: Samuel E. Buttrey, Department of Operations Research
Daniel R. Dolk, Department of Information Sciences
Second Reader: Kathryn Kocher, Graduate School of Business and Public Policy

This thesis analyzes the effects of commissioning sources on the retention and promotion of U.S. Army officers.

The data in this thesis were taken from the Active Duty Military Master File, with separate data sets for cohorts commissioned from 1981 through 2001. Three logistic regression models are described: retention to the grade of O-4, promotion to O-4, and promotion to O-5.

It is concluded that Academy graduates have the lowest retention rates, whereas Officer Candidate School (OCS) graduates have the highest retention rates. Among male officers, retention rates are higher for Reserve Officer Training Corps (ROTC) graduates than for those with direct appointments; among female officers, retention rates are higher for direct appointments than ROTC graduates. The promotion to O-4 model indicates that the effect of commissioning source is different within gender, race, and marital status groups. The results of the promotion to O-5 model contrasts with those of the O-4 models. Academy graduates are more likely to be promoted to Lieutenant Colonel than those from other sources, followed by ROTC graduates, and then direct appointments.

The effects of the Army's reduction in force ("drawdown") between 1989 and 1996 are not accounted for in this thesis, as they cannot be modeled with the data at hand.

KEYWORDS: U.S. Army, Officer Commissioning Sources, Officer Career Development, Retention, Promotion, Logistic Regression

UTILITY AND APPLICABILITY OF THE SHARABLE CONTENT OBJECT REFERENCE MODEL (SCORM) WITHIN NAVY HIGHER EDUCATION
Mohammad B. Kohistany-Lieutenant, United States Naval Reserve
B.S., University of Maryland, 2000
Master of Science in Information Technology Management-June 2004
Ilias Z. Zacharopoulos-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1991
Master of Science in Information Technology Management-June 2004
Advisor: Dale Courtney, Department of Information Sciences
Second Reader: Glenn Cook, Department of Information Sciences

This thesis critically analyzes the Sharable Content Object Reference Model (SCORM) within higher education, and examines SCORM’s limitations within a realistic application environment versus within a theoretical/conceptual platform. The thesis also examines environments better suited for implementation of SCORM technology. In addressing the research questions, it is discovered that from the current standards set forth by Advanced Distributed Learning (ADL), SCORM is not well suited for higher education. SCORM technology will prove of greater utility within the Navy training environment than in higher education. In efforts to share information, higher education institutions would benefit more from a Content Management System in conjunction with a Learning Management System. Subsequent chapters address the limitations of SCORM, provide a comparison of the applicability of SCORM within the separate domains of Naval Education and Training, and provide a prototype of a Content Management System for institutions of higher learning.

KEYWORDS: Sharable Content Object Reference Model, SCORM, Advanced Distributed Learning initiative, ADL, Content Management System, CMS, Navy Education and Training, Distance Learning
The purpose of this study is to determine whether Naval Medicine’s current Information Assurance Policy and resultant efforts properly address federal requirements and current threats confronting Naval Medicine information technology professionals. The primary research is conducted with a survey instrument detailing thirty questions with various response categories. The findings of the survey questionnaire reveal the existing numbers of previously compromised systems are directly related to the frequency of vulnerability scanning and remediation practices in the current threat environment. This study provides insight to the future assessment of Naval Medicine’s information security posture. These findings have important implications for command personnel charged with the responsibility and accountability of Naval Medicine’s networks and data systems, as well as other communities throughout the Navy.

**KEYWORDS:** Vulnerability Assessment, Patch Management, Information Assurance, Naval Medicine, Vulnerability Statistics, Scans, Scanning
THE NATIONAL SECURITY PERSONNEL SYSTEM: DEPARTMENT OF DEFENSE CIVILIAN PERSONNEL STRUCTURES AND THE U.S. LEGISLATIVE PROCESS
Sean M. Foss-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Leadership and Human Resource Development-June 2004
Advisor: Richard B. Doyle, Graduate School of Business and Public Policy
Second Reader: CDR Phil J. Candreva, USN, Graduate School of Business and Public Policy

In April 2003, the Bush Administration submitted the Defense Transformation for the 21st Century Act to 108th U.S. Congress for review and enactment. This act proposed broad changes for the Department of Defense (DoD) to successfully meet new challenges and new threats for the 21st century. This paper examines the proposals and requested authorities relating to modernizing civilian personnel structures found in the proposed National Security Personnel System. Specifically, this paper studies the political process used to change DoD policy, by analyzing the legislative outcome of the National Security Personnel System. In November 2003, the legislative treatment of the Bush Administration’s proposal was finalized by the passage of the National Defense Authorization Act for Fiscal Year 2004.


DEVELOPING DECISION-MAKING SKILLS IN UNITED STATES NAVAL ACADEMY MIDSHIPMEN
Daniel P. Healey-Major, United States Marine Corps
B.A., College of the Holy Cross, 1993
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Gail Fann Thomas, Graduate School of Business and Public Policy
Janice Laurence

This study shows the importance of decision making skills in a military leader. Different models of decision making are examined and effective ways to teach decision making are presented. If, as the literature shows, decision making is an important skill for an officer, one would assume that the United States Naval Academy (USNA) would have a well-defined, clearly articulated program that ensures its graduates are, in fact, well-trained in decision making; this study tests that assumption. It presents what the Naval Academy's senior leadership's goals and priorities are for developing midshipmen as decision makers. The study also determines the value placed on decision making abilities by those primarily responsible for the professional development of midshipmen, and how well they believe the Naval Academy prepares midshipmen for the decision making responsibilities they will face as officers. Opportunities for midshipmen to make decisions are identified, and midshipmen were asked how well they think the Naval Academy prepares them to be decision makers. The findings of this study assess the extent to which the Naval Academy presently develops decision making skills in its midshipmen.

KEYWORDS: Decision Making, Leadership, Training, Education, Naval Academy, Midshipmen
JUNIOR OFFICER ORAL COMMUNICATION IN NAVY AND MARINE CORPS
John M. Long-Lieutenant, United States Naval Reserve
B.S., Hampden-Sydney College, 1998
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Gail Fann Thomas, Graduate School of Business and Public Policy
Anne-Marie Drew, United States Naval Academy

Communication is an essential skill for every military officer. Their jobs are accomplished through communication as they motivate soldiers and sailors, who in turn physically accomplish the diverse missions of the military. Junior officers in the Navy and Marine Corps hold key and challenging positions in any ship or unit. While they rarely originate any major initiatives or missions, they almost always give the final order or direction. Therefore, they must be able to accurately communicate both up and down the chain of command. While communicating comes easily to some junior officers, many struggle with it, and most have room for improvement.

The United States Naval Academy (USNA) recognizes the important role that it can play in developing junior officer communication abilities. One of the Academy’s strategic initiatives is “Oral and Written Communications Excellence.” The focus of this thesis is oral communications. This thesis identifies the types of oral communications prevalent in the fleet, the important communication skills that a junior officer must master, and how the Naval Academy and other institutions can help develop these skills in the future leaders of the Navy and Marine Corps.

KEYWORDS: Oral Communication, Junior Officer, Socialization, Leadership, Communication Education, Officer Training

LIVE FROM THE BATTLEFIELD: AN EXAMINATION OF EMBEDDED WAR CORRESPONDENTS’ REPORTING DURING OPERATION IRAQI FREEDOM
(21 MARCH-14 APRIL 2003)
Michael J. Mooney-Major, United States Marine Corps
B.S., United States Naval Academy, 1992
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Alice Crawford, Graduate School of Business and Public Policy
Gail Fann Thomas, Graduate School of Business and Public Policy

During Operation Iraqi Freedom (OIF), the U.S. Department of Defense (DoD) instituted a program to attach civilian journalists to coalition military units. Their purpose was to report firsthand on the military campaign to topple Saddam Hussein. These “embedded journalists,” as they were called, would travel, eat, sleep, and endure the same hardships and dangers as the soldiers and Marines they were accompanying. While their immediate and highly dramatic accounts offered a perspective not previously seen by the news-hungry U.S. public, they also raised questions about whether the “embedding” process resulted in a more thematically narrow coverage of the war. This study addresses the newspaper coverage of OIF by examining the content of the embedded and non-embedded war reporting of various highly circulating U.S. newspapers. It posits that journalists who are attached or embedded within U.S. military units produce a body of stories concerning military operations and personnel markedly different than non-embedded reporters during OIF.

KEYWORDS: Operation Iraqi Freedom, Embedded Journalists
LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

THE IMPACT OF THE SUMMER SEMINAR PROGRAM ON MIDSHIPMAN PERFORMANCE: DOES SUMMER SEMINAR PARTICIPATION INFLUENCE SUCCESS AT THE NAVAL ACADEMY?

Michael A. Norton-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Armando Estrada, Graduate School of Business and Public Policy
Linda Mallory, United States Naval Academy

It is unknown if the Summer Seminar Program, which gives rising high school seniors a six-day look at Naval Academy life, has resulted in a more successful midshipman. While not previously discussed in literature, there are numerous studies on civilian recruiting and orientation programs as well as realistic job previews and expectation-lowering procedures. Based on this literature, it is theorized that Summer Seminar Program participation positively correlates to increased graduation rates, increased academic cumulative quality point ratings, and increased military and physical performance. This hypothesis is tested using multiple hierarchical regressions on population data obtained from the classes of 1997 through 2003. Success is defined using seven dependent variables organized by academic, military, and physical performance. The key independent variable is participation in the Summer Seminar Program, while eleven other independent variables control for demographics, selection criteria, and proven indicators of success. Participation in the Summer Seminar Program has a significant relation to increased graduation rates, increased academic cumulative quality point ratings, increased military cumulative quality point ratings, and increased physical readiness test scores. This study concludes that the Summer Seminar Program makes a unique contribution to midshipman success at the Naval Academy.

KEYWORDS: Summer Seminar Program, College Recruiting, College Orientation, Realistic Job Preview, Expectation-lowering Procedure, Performance, Academic Performance, Military Performance, Physical Performance, United States Naval Academy, USNA, Midshipman, Midshipmen, College Admissions

ORGANIZATIONAL CYNICISM AT THE UNITED STATES NAVAL ACADEMY: AN EXPLORATORY STUDY

Leighton J. Pitre-Lieutenant, United States Navy
B.S., United States Naval Academy, 1998
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: LCDR Roderick Bacho, USN, United States Naval Academy
Susan P. Hocevar, Graduate School of Business and Public Policy

Organizational cynicism is an attitude, characterized by frustration and negatively valenced beliefs, resulting primarily from unmet expectations, which is capable of being directed towards an organization in general and/or more specific facets of the organizational environment (Brockway, Carlson, Jones, and Bryant, 2002). This thesis studies the causes of organizational cynicism at the United States Naval Academy. The study is based on focus groups of 30 first class midshipmen (i.e., seniors). Gaps in expectations versus students’ reality emerge as a cause of organizational cynicism. Themes such as: 1) constraints on decision making discretion, 2) disappointment in peers’ actions, 3) organizational inconsistencies, and 4) emphasis on outside interests versus midshipmen’s interests emerge as the strongest precursors to the development of cynicism. The effects of organizational cynicism are reported as: 1) lack of organizational commitment and citizenship, and 2) deficiencies in decision making and risk taking skills.

KEYWORDS: Organizational Cynicism, Unmet Expectations, Expectations Versus Reality, Decision-making Discretion, Disappointment, Organizational Inconsistencies, Outside Interests, Development of Cynicism, Organizational Commitment, Organizational Citizenship, Decision Making Skills, Risk Taking Skills
LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

RETENTION OF RECRUITED ATHLETES FROM THE UNITED STATES NAVAL ACADEMY
Richard A. Robbins, Jr.-Lieutenant, United States Naval Reserve
B.S., United States Naval Academy, 1999
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Armando Estrada, Graduate School of Business and Public Policy
William Bowman, United States Naval Academy

This study examines fleet retention rates of United States Naval Academy (USNA) graduates who participated in varsity athletic programs from 1988 to 1990 and remained in service beyond their initial obligation (N = 2,735). It is based on a theoretical model investigating two forces of influence on retention: varsity athlete status as a positive influence and recruit status as a negative influence. Results of the hierarchical logistic regression analyses validate the theoretical model and suggest that varsity athletic participation and recruit status do have an impact on fleet retention rates. The negative retention influence of recruit status and the positive retention influence of varsity athletic participation are observed through the interaction of these two forces. Results indicate that recruit status is significantly related to lower retention rates; however, this negative force is counterbalanced by the positive influence of sustained varsity athletic participation, should the athlete have the perseverance to letter in his or her sport. This study also identifies the walk-on varsity athlete as the true beneficiary of the human capital benefits associated with varsity athletic participation. The walk-on varsity athlete acquires leadership and teamwork skills attributed to participation in varsity athletics, without the negative recruit influence.

KEYWORDS: Retention, United States Naval Academy, Varsity Athletes, Recruited Athletes

A QUALITATIVE ANALYSIS OF SELECTION TO FLAG RANK IN THE UNITED STATES NAVY
David A. Schwind-Lieutenant, United States Navy
B.S., Regents College, State University of New York, 1998
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Janice Laurence
William Bowman, United States Naval Academy

This thesis is a qualitative analysis of selection to Rear Admiral (Lower Half) in the United States Navy. Specifically, this thesis examines the variables in the career of senior U.S. Navy officers that can be considered as factors in determining advancement at the O-7 selection board. Semi-structured interviews were conducted with active duty and retired flag officers. Interview protocol is based on an analysis of archival data from flag officers promoted from year groups 1972 to 1978 and relevant literature, to determine what factors are considered during the selection board process. Overall, the data indicate that select background and performance variables are important factors in the promotion of flag officers. Examples include the importance of reputation and fitness report rankings and the lack of weight given to factors such as commissioning source and letters of recommendation.

KEYWORDS: Senior Officer Promotion, Flag Officer Selection

PARENTAL DIVORCE AND MIDSHIPMEN PERFORMANCE AT THE UNITED STATES NAVAL ACADEMY
Allen M. Siegrist-Lieutenant, United States Naval Reserve
B.S., United States Naval Academy, 1999
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Linda Mallory, United States Naval Academy
Brad Johnson, United States Naval Academy

This study examines the relationship of parental divorce to the performance of Naval Academy midshipmen. Parental Status was determined by the American College of Education (ACE) survey, completed in the plebe year. Parental Status of midshipmen is merged with Institutional Research Data to determine effects of parental divorce on midshipmen performance. For the purposes of the study, numerous
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aspects of performance are measured: 1) academic grade point average, 2) military grade point average, 3) conduct, 4) attrition rates, 5) participation in varsity athletics, and 6) leadership responsibilities. The common expectation is that midshipmen from divorced families perform lower than midshipmen from intact families. Lower performance is noted in academic and military grade point averages, attrition, and participation in varsity athletics among midshipmen from divorced families. No significant difference in performance is noted in conduct or leadership responsibilities.

KEYWORDS: Divorce, Parental Divorce, Divorce Effects, Performance, Military, Attrition, Leadership

EFFECTS OF MILITARY/FAMILY CONFLICT ON FEMALE NAVAL OFFICER RETENTION
Cody S. Sinclair-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Janice Laurence
Michael J. Schwerin, RTI International
A significant relationship exists between work/non-work factors and retention plans among enlisted military personnel (Wilcove, Schwerin, & Wolosin, 2003; Hindelang, Schwerin, & Farmer 2004). An examination of “quality of life” (QOL) survey data found that married enlisted sailors with children who were satisfied with non-work factors (i.e., personal development, shipboard life, standard of living/income, relationship with children, marital relationship, health) were more likely to display reenlistment intentions whereas satisfaction with work factors (i.e., professional development, shipboard life, overall QOL) was related to reenlistment intentions only indirectly through its positive effect on organizational commitment (Wilcove, Schwerin, & Wolosin, 2003). Female officers are often overlooked in military QOL research; however they face the same, if not more difficult, work/family conflicts than their civilian counterparts or their male military compatriots. Data from the 2002 Navy Quality of Life Survey were used to examine life domains where work/family conflict has the greatest impact on retention. Hierarchical regression was used to identify life domains (e.g., family factors, job experiences, job satisfaction, and commitment) that are key drivers of retention intent among female Naval officers. By identifying areas that are strongly related to female officer retention intentions, policymakers can explore developing strategies to support female officers, such as family support programs, mentoring programs, or professional support networks.

KEYWORDS: Officer Retention, Work/Family Conflict, Female Naval Officer, Military Family

AN ANALYSIS OF JUNIOR OFFICER PERFORMANCE AT THE SURFACE WARFARE OFFICER SCHOOL DIVISION OFFICER COURSE
Michael R. Vaas-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Janice Laurence
Second Reader: Alice Crawford, Graduate School of Business and Public Policy
The Surface Warfare Officer community has begun a series of fundamental changes in the methods used to train junior officers. Since 1970, newly commissioned officers reported to the Surface Warfare Officers School (SWOS) to attend the Division Officer Course. This school was designed to expose and educate prospective division officers to the tasks and equipment they would be expected to manage once they reported to their first ship. The majority of the material from this classroom training will now be completed onboard ship, using computer-based training and Personnel Qualification Standards (PQS). This study will examine junior officer performance at the previous SWOS Division Officer Course. Specifically, it will identify areas where newly commissioned officers have had difficulty in the past and, using selected background variables, predict the performance of various groups under the new training regime. The secondary objective is to create a model to predict areas in the curriculum that cause problems for certain groups.
LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

KEYWORDS: Officer Performance, Officer Commissioning Programs, Officer Measures of Effectiveness, Surface Warfare Officer

AN ANALYSIS OF MARINE CORPS SERVICE ASSIGNMENT AT THE UNITED STATES NAVAL ACADEMY
Scott W. Wadle-Major, United States Marine Corps
B.S., United States Naval Academy, 1994
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Alice Crawford, Graduate School of Business and Public Policy
J. Eric Fredland, United States Naval Academy

This study examined individual midshipman’s first class (senior year) leadership positions, academic and military grade point averages, course of study, prior-enlisted Marine status, family affiliation with the Marine Corps, and status as a varsity letter recipient as predictors of assignment to the United States Marine Corps upon graduation from the United States Naval Academy. A review of the service assignment process and Marine Corps selection criteria is provided as a historical background. Nine cohorts of subjects were studied from the period 1995-2003 to derive the most prevalent characteristics associated with Marine Corps selection. Results of a series of binary logistic regressions showed that the variables measuring Marine Corps enculturation (i.e., prior-enlisted Marine status and legacy status) serve as the best predictors of an assignment to the Marine Corps. For the population of midshipmen that were neither prior-enlisted Marines nor legacies, the variables measuring leadership experience serve as the best predictors. This investigation also includes a synopsis of the Marine selection panel’s proceedings to educate Naval Academy faculty, company officers, and midshipmen who aspire to become Marine Corps officers as to the process the selection panel uses in selecting its midshipmen.

KEYWORDS: United States Marine Corps, United States Naval Academy, Service Assignment, Leadership, Leatherneck, The Basic School, TBS

AN ANALYSIS OF MENTORING TRAITS AND THEMES INFLUENTIAL IN THE POTENTIAL RETENTION OF MINORITY STUDENTS AT THE UNITED STATES NAVAL ACADEMY
Demetrius Wilkins-Lieutenant, United States Navy
B.A., University of Illinois-Chicago, 1996
Master of Science in Leadership and Human Resource Development-June 2004
Advisors: Janice Laurence
Gail Fann Thomas, Graduate School of Business and Public Policy

This study was designed to examine mentoring of minority midshipmen at the United States Naval Academy (USNA). Mentoring has long been practiced in the business world to introduce new employees to their new assignments, positions, or jobs. This study searched for the effects of mentoring on black and white male midshipmen and examined the distinguishing features that make mentoring a positive experience for the mentor and protégé alike. Additionally, this study looked at the features of mentoring that may influence minority midshipmen to remain at the USNA and in the United States Navy as well. Focus groups with over 50 participants were conducted and content analyzed for reliable themes. Although there seems to be mistrust of faculty and staff, upperclassmen are an invaluable and sought after source of specific information. Further, minorities especially seek networks such as sports teams and “Black” clubs for support. In such homogeneous networks, minority midshipmen are less likely to feel vulnerable or inadequate when seeking information.

KEYWORDS: Mentoring, Mentors, Protégés, Coaching, Minority Mentoring
This study evaluates the impacts of physical attractiveness and sex on periodic midshipman performance evaluations at the United States Naval Academy. An experiment is conducted in which 138 senior-ranking male midshipmen are each provided an identical performance summary report along with one of four Naval Academy yearbook photographs and then asked to evaluate the midshipman in the photograph using only the information provided. The target midshipman is presented as either an attractive or unattractive male or female sophomore-level midshipman who demonstrates an average level of performance. The significant finding is that physical attractiveness and sex do influence evaluation scores. The attractive midshipmen receive higher overall evaluation scores than the unattractive midshipmen, and the attractive female midshipman receive the highest overall evaluation scores. The purpose of this study is to increase awareness of physical attractiveness and sex biases and their impact on performance evaluations. This study also makes training recommendations and suggestions for further research on this topic that will benefit the United States Naval Academy.

**KEYWORDS:** United States Naval Academy, Gender Bias, Sex Bias, Physical Attractiveness, Performance Evaluation, Midshipman

Remegio M. de Vera-Lieutenant Colonel, Philippine Army
B.S., Philippine Military Academy, 1981
Master of Science in Management-June 2004
Advisors: Richard B. Doyle, Graduate School of Business and Public Policy
Jeffrey R. Cuskey, Graduate School of Business and Public Policy

The Philippine government uses two methods to procure defense articles from the United States, either Foreign Military Sales (FMS) or Direct Commercial Sales (DCS). This thesis examines the differences between FMS and DCS as methods of procurement used by the Philippine government in the acquisition of U.S. defense articles. The study identifies the processes involved in each of the two procurement methods, as well as the advantages and disadvantages of each when used within the socioeconomic and political environment of the Philippines. Issues and considerations that influence selection decision are also discussed. DCS offers the lowest fixed price, timely/earlier delivery, easier countertrade arrangements, and penalty for non-compliance to the provisions of the contract. FMS is preferable because it is a government-to-government sale, provides opportunities for Philippine military training in the United States, and enhances interoperability among coalition forces. In addition, FMS allows for financing of defense articles from the U.S. using Foreign Military Financing, thus conserving Philippine government funds.

KEYWORDS: Foreign Military Sales, Direct Commercial Sales, Armed Forces of the Philippines, Security Assistance, Armed Forces of the Philippines Modernization Program

ADULT LEARNING AND NAVAL LEADERSHIP TRAINING
Melanie J. Hitchcock-Commander, United States Navy
B.A., University of California-Berkeley, 1985
Master of Science in Management-June 2004
Advisors: Alice Crawford, Graduate School of Business and Public Policy
Stephen L. Mehay, Graduate School of Business and Public Policy

Adult learning embraces andragogy, constructivism, Transformative Learning Theory, praxis, and the understanding that not all adults are prepared initially for complete learning autonomy. The concept of andragogy can be found as far back as the nineteenth century and volumes of follow-on research have reinforced the basic tenants of adult learning. It is, therefore, valid to expect that adherence to the Adult Learning Model will indicate the effectiveness of curricula that target adults.

This thesis analyzes the Center for Naval Leadership facilitator training course and the Center for Naval Leadership Learning Site, Coronado Advanced Officer Leadership Training Course curricula for adherence to the Adult Learning Model to draw conclusions about their effectiveness.

KEYWORDS: Andragogy, Adult Learning
This thesis analyzes the relationship between predicted system reliability and planned spare parts levels. This analysis is accomplished through the integration of factors impacting spare parts levels and life cycle costs into a spreadsheet model that establishes the appropriate relationship between the factors. This thesis determines the impact that varying estimations of reliability have on both life cycle costs and spares levels for the H-1 Upgrades Program. Examples of the spreadsheet input and output are included as appendices.

**KEYWORDS:** Spare Parts, Life Cycle Costs, Reliability, Spares Protection Level, AH-1W, UH-1N, AH-1Z, UH-1Y, H-1 Upgrades Program
In this thesis, weapon effectiveness methods are compared to determine if current effectiveness models provide accurate results. The United States military currently adheres to a compilation of data and methodologies named the Joint Munitions Effectiveness Manuals (JMEM) to determine the effectiveness of air delivered weapons against a variety of ground targets. Since the time these manuals were implemented in the 1960s, progress in technology has allowed the weapon/target interaction to be more accurately modeled. This thesis investigates the differences of these high fidelity models for unguided weapons and the JMEM computations in order to determine whether the older, more simplistic models need to be upgraded.

KEYWORDS: Weapon engineering, Weapon Effectiveness, Monte Carlo Simulations

A computational fluid dynamic (CFD) investigation is presented that provides predictions of the aerodynamic impact of uniform and non-uniform coatings applied to the leading edge of a compressor airfoil in a cascade. Using a National Advisory Committee for Aeronautics (NACA) 65(12)10 airfoil, coating profiles of varying leading edge non-uniformity are added. This non-uniformity is typical of that expected due to fluid being drawn away from the leading edge during the coating process. The CFD code, RVCQ3D, is a steady, quasi-three-dimensional Reynolds Averaged Navier-Stokes (RANS) solver. A k-omega turbulence model is used for the Reynolds’ Stress closure. The code predicts that these changes in leading edge shape can lead to alternating pressure gradients in the first few percent of chord that create small separation bubbles and possibly early transition to turbulence. The change in total pressure loss and trailing edge deviation are presented as a function of the coating non-uniformity parameter. Results are presented for six leading edge profiles over a range of incidences and inlet Mach numbers from 0.6 to 0.8. The Reynolds number was 600,000 and free-stream turbulence was 6%. A two-dimensional map is provided that shows the allowable degree of coating non-uniformity as a function of incidence and inlet Mach number.

KEYWORDS: Compressor Aerodynamics, Leading Edges, Separation Bubbles, Computational Fluid Dynamics, CFD, Coated Airfoils
Because of the large number of ships crippled by indirect detonations during World War II, the U.S. Navy took an interest in underwater explosion phenomena. To ensure future ship survivability, Navy rules soon dictated that the first ship in every new class or flight would be subjected to ship shock test trials. The Navy selected the Arleigh Burke class destroyer, USS WINSTON S. CHURCHILL (DDG-81), as the most recent platform and subjected it to an underwater explosion 2/3 the magnitude of the design level shot. Actual detonation of the design level shot was not conducted due to the high risk of failure. The thesis predicts the effects of the full design level shot and investigates its relationship to the 2/3 shot data.

**KEYWORDS:** Ship Shock, Shock Trials, Shock and Vibration, UNDEX, Underwater Explosion, Modeling and Simulation, USS WINSTON S. CHURCHILL, DDG-81, Underwater Shock Analysis, USA Code

The flow around second-generation controlled-diffusion blades in cascade at stall is examined experimentally through the use of a two-component laser-Doppler velocimeter (LDV). Blade surface pressure measurements are also preformed at mid span on the blades at various Reynolds numbers. Flow visualization techniques are used to observe and record the flow on the surface of the blade. A correlation between the experimental results and computational fluid dynamic predictions is attempted in order to determine the exact nature of the flow as the blades approached stall, to further assist in the development of advanced blade design. The blade surface pressure measurements show that the mid-span section of the blade is at a lower loading than previously measured at a smaller inlet flow angle. This indicates the blade section was at stall. The flow visualization highlights the extent of the three-dimensional flow over the blades. The LDV measurements document the mid-span boundary layer and wake profiles.

**KEYWORDS:** Controlled-diffusion, Compressor, Stator, Cascade, Turbomachinery, Laser Doppler Velocimetry

Ship shock testing is a live fire testing and evaluation process designed to determine the vulnerabilities of a surface combatant. Such testing is inherently dangerous to the crew, the ship, and the environment and as a result, shock simulation models were created to provide an alternative. With the improvement of computing power, simulation models are growing ever more complex and realistic.

Engineering studies strive for a balance to gather useful knowledge as quickly and as efficiently as current technologies allow. Accordingly, limited by current technologies and with the intention for future advancements, this study addresses the simplest of plasticity studies.
The current study models dynamic elastoplastic response through material property changes. This model provides significant contributions to structural modeling by first using a ship-like box model followed by a two-thirds design shot model of the USS WINSTON CHURCHILL (DDG-81) to compare elastic (no deformation) to elastoplastic (plastic deformation) response. A brief study is also conducted for the full design shot to show its versatility in predicting up to and beyond a ship’s structural limit.

As plasticity studies continue to improve, such models will prove to be more representative of reality and perhaps future ships can be modeled as well as shock tested during the design phase, before the keel is laid.


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**A COMPUTATIONAL STUDY OF THE EFFECT OF CROSS WIND ON THE FLOW OF FIRE FIGHTING AGENT**

Alexandra Myers-Ensign, United States Navy  
B.S., United States Naval Academy, 2003  
Master of Science in Mechanical Engineering-June 2004  
Advisor: Matthew D. Kelleher, Department of Mechanical and Astronautical Engineering  
Second Reader: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

This research evaluates the feasibility of robotically, or remote-controlled, firefighting nozzles aboard air-capable ships. A numerical model is constructed and analyzed, using the program CFD-ACE, of a fire hose stream being deflected by the influence of a crosswind, tailwind, or headwind. The model predicts the reach of the fire hose stream, indicates the distribution pattern, and estimates the volume of fire fighting agent available at the end of the stream. Preliminary results for a two fluid cross-flow model are obtained.

**KEYWORDS:** Damage Control, Computational Fluid Dynamics Modeling, Aircraft Carrier Flight Deck Fire, Fluid Jet Stream, Air Cross Wind, Flight Deck Firefighting

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**EVALUATION AND ANALYSIS OF DDG-81 SIMULATED ATHWARTSHIP SHOCK RESPONSE**

Douglas C. Petrusa-Lieutenant, United States Coast Guard  
B.S., United States Merchant Marine Academy, 1997  
Master of Science in Mechanical Engineering-June 2004  
Advisor: Young S. Shin, Department of Mechanical and Astronautical Engineering

In 2001, the USS WINSTON CHURCHILL (DDG-81) was subjected to three underwater explosions as part of a ship shock trial. Using the actual trial data from the experiment and three-dimensional dynamic models of the ship and surrounding fluid, very successful comparisons of the vertical motion were achieved. On average, the magnitude of the vertical motion is three to four times the magnitude of athwartship motion. Previous simulations of this athwartship motion have been less accurate than the vertical motion simulations.

This thesis examines recent attempts to improve the simulation results of the athwartship motion, including shock spectra analysis, and the reasons behind the disparities that exist between the simulated values and the actual trial data.

**KEYWORDS:** Athwartship Motion, Shock Spectrum Analysis
EXPERIMENTS WITH THE REMUS AUV
Matthew D. Phaneuf-Lieutenant, United States Navy
B.S., University of South Carolina, 1997
Mechanical Engineer-June 2004
Master of Science in Mechanical Engineering-June 2004
Advisor: Anthony J. Healey, Department of Mechanical and Astronautical Engineering

This thesis centers on actual field operations and post-mission analysis of data acquired using a Remote Environmental Monitoring Unit (REMUS) Autonomous Underwater Vehicle (AUV) operated by the Naval Postgraduate School Center for Autonomous Underwater Vehicle Research. It was one of many platforms that were utilized for data collection during Autonomous Oceanographic Sampling Network II (AOSN II), an Office of Naval Research (ONR) sponsored exercise for dynamic oceanographic data taking and model based analysis using adaptive sampling. The vehicle’s ability to collect oceanographic data consisting of conductivity, temperature, and salinity during this experiment is assessed and problem areas are investigated. Of particular interest are the temperature and salinity profiles measured from long transect runs of 18 kilometer length into the southern parts of Monterey Bay. Experimentation with the REMUS as a mine detection asset was also performed. The design and development of the mine hunting experiment is discussed, as well as results and analysis. Of particular interest in this portion of the work is the issue relating to repeatability and precision of contact localization, obtained from vehicle position and sidescan sonar measurements.

KEYWORDS: REMUS, AUV, Autonomous Underwater Vehicle, Mine Hunting, AOSN

AUTONOMOUS VISUAL TRACKING OF STATIONARY TARGETS USING UNMANNED AERIAL VEHICLES
Robert A. Prince-Ensign, United States Naval Reserve
B.S., Duke University, 2003
Master of Science in Mechanical Engineering-June 2004
Advisor: Isaac I. Kaminer, Department of Mechanical and Astronautical Engineering
Second Reader: Ick Ho Whang, Department of Mechanical and Astronautical Engineering

A control system is developed for autonomous visual tracking of a stationary target using a small unmanned aerial vehicle. The kinematic equations of this problem are developed, and the insight obtained from examination is applied in developing controllers for the system. This control system controls the orientation of the camera to keep it constantly pointing at the target, and also controls the trajectory of the aircraft in flight around the target. The initial control law that is developed drives the aircraft trajectory to a constant radius around the target. The range to the target is not directly measurable, so it is estimated using steady state Kalman filters. Once a range estimate is obtained, it is used to control the range to the target, and the aircraft trajectory is driven toward a circle with a specified radius. Initial tests of the control system with Simulink simulations have shown good performance of the control system. Further testing with hardware will be conducted, and flight tests are scheduled to be conducted in the near future. Conclusions are drawn and recommendations for further study are presented.

KEYWORDS: Unmanned Aerial Vehicle, UAV, Autonomous Guidance, Target Tracking, Control, Visual Target Tracking, Range Estimation, Triangulation, Kalman Filter, Piccolo, xPC Target
The impact of non-conventional observations and increased horizontal resolution on the numerical weather prediction (NWP) system of the National Center for Aeronautic Meteorology and Climatology of the Italian Air Force (CNMCA) has previously been investigated in other research. The present study is part of ongoing research activities seeking to improve CNMCA’s operational numerical weather prediction capabilities through the assimilation of non-conventional observations. Additional data are derived from satellite observations, such as 10 m wind retrieved from Quikscat polar-orbit satellite, atmospheric motion vectors (AMVs) from Meteosat geostationary satellites, and manual and automated aircraft observations. The NWP system is in operational use and is based on an “observation space” version of the 3D-Var method for the objective analysis component (3D-PSAS), while the prognostic component is based on the High Resolution Regional Model (HRM) of the German Meteorological Service (DWD). The analysis and forecast fields derived from the NWP system are objectively evaluated through comparisons with radiosonde and conventional surface observations. Comparisons with parallel runs of the HRM model starting from the 3D-Var operational analysis show that each of those observations have a measurable positive impact on forecast skill.

KEYWORDS: Objective Analysis, Data Assimilation, Meteorological Observation, Observing System Experiment, Impact Study
Naval operations are highly dependent upon environmental conditions that can either adversely affect successful completion or hinder the safety of personnel. Each warfare community has defined environmental thresholds and operating limits that restrict the execution of any intended maneuver. As the warfare environment continues to shift from open ocean to the littoral, environmental prediction and modeling efforts of the shallow water surroundings need to be developed in order to support these operations. A hydrodynamic model, Water Quality Management and Analysis Package (WQMAP), has been developed by Applied Sciences Associates, Inc. This model is designed specifically to provide accurate littoral environmental prediction. WQMAP is one of several hydrodynamic models used operationally by the Naval Oceanographic Office (NAVOCEANO) to predict currents and water elevations in littoral regions. Implementations of shallow water hydrodynamic models in foreign waters are usually data-starved for model forcing and validation. In a series of studies, NAVOCEANO intends to model various bays within the continental United States, where sufficient data exists, to study the sensitivity of lack of data on model results. This study utilizes WQMAP to design a hydrodynamic model in San Diego Bay to predict currents and investigate the impact of grid resolution on model results, and to provide accurate current predictions for Fleet training and operations.

**KEYWORDS:** Hydrodynamic Model, WQMAP, Modeling and Simulation, Oceanography, Mine Warfare, Explosive Ordnance Disposal

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**EFFECTS OF A SUSPENDED SEDIMENT LAYER ON ACOUSTIC IMAGERY**

Michael Cornelius-Lieutenant, United States Navy  
B.S., United States Naval Academy, 1996  
Master of Science in Meteorology and Physical Oceanography-June 2004  
Advisor: Peter C. Chu, Department of Oceanography  
Second Reader: Melvin Wagstaff, Naval Oceanographic Office, Stennis Space Center

The Navy’s Comprehensive Acoustic Simulation System/Gaussian Ray Bundle (CASS/GRAB) sonar model is used to accurately simulate a side-scan sonar image with a mine-like object present through its reverberation characteristics. The acoustic impact of a suspended sediment layer is investigated numerically using CASS/GRAB through changing the volume scattering characteristics of the lower water column. A range of critical values of volume scattering strength are discovered through repeated model simulations. An understanding of the acoustic characteristics of suspended sediment layers can aid the Navy in the detection of mines that might exist within these layers.

**KEYWORDS:** CASS/GRAB, Modeling and Simulation, Oceanography, Mine Warfare Nepheloid Layer, Bottom Boundary Layer
ASSESSING THE PERFORMANCE OF OMNI-DIRECTIONAL RECEIVERS FOR PASSIVE ACOUSTIC DETECTION OF VOCALIZING ODONTOCETES

John M. Daziens-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1990
M.S., Johns Hopkins University, 1999
Master of Science in Meteorology and Physical Oceanography-June 2004
Advisors: Ching-Sang Chiu, Department of Oceanography
Curtis A. Collins, Department of Oceanography

Acoustic detection and localization of marine mammals will assist mitigation efforts for various Naval and scientific missions that may impact protected species. This study experimentally quantifies the sonar performance of omni-directional receivers as a means to passively detect vocalizing Odontocetes in coastal waters. To accomplish this objective, controlled experiments using a calibrated mid-frequency sound source are conducted on the San Clemente Island Underwater Range (SCIU R) in July 2002. Six Odontocete signals are selected for transmission based upon availability and quality of archived recordings: two orca and two pilot whale whistles, and sperm whale and Risso's dolphin clicks. Several hundred iterations of each signal are broadcast from R/V Point Sur at stations 300 m to 12,000 m from the range's moored, three-element array. Statistical analyses are performed on the output of an energy and matched filter detector to quantify detection probability and range limits as a function of false alarm rate, signal type, and signal to noise ratio (SNR). The matched filter generally outperforms the energy detector with respect to the required signal to noise ratios and maximum detection range for given probabilities of detection P(D) and false alarm rate P(FA). The matched filter detects the orca2 and pilot1 whistles beyond 5000 m with a 90% P(D), 1% P(FA), and source level (SL) of 140 dB re 1 µPa. For the same conditions, the orca1 and sperm whale calls were detected at 1500 m, but the pilot2 and Risso's dolphin signals were not detected at the peak realized SNR of -2 dB. The energy detector had no detections with a 90% P(D) and 1% P(FA) at this -2 dB SNR, but all signals except one orca whistle were detectable beyond 1000 m with a 50% P(D) and 1% P(FA). The sperm whale was the exceptional energy detector performer, with detection ranges exceeding 7 km (140 dB re 1 µPa SL) at the 50% P(D) and 1% P(FA).

KEYWORDS: Oceanography, Acoustics, Marine Mammals, Whales

INTRASEASONAL, LARGE-SCALE CIRCULATIONS AND TROPICAL CYCLONE ACTIVITY OVER THE WESTERN NORTH PACIFIC DURING BOREAL SUMMER

Tracey Lee Delk-Lieutenant, United States Navy
B.S., United States Naval Academy, 1996
Master of Science in Meteorology and Physical Oceanography-June 2004
Advisor: Patrick A. Harr, Department of Meteorology
Second Reader: Russell L. Elsberry, Department of Meteorology

Large-scale circulations in the 15-25 day period over the western North Pacific during northern summer are determined using the leading modes of a Singular Value Decomposition of 850 hPa winds and outgoing longwave radiation. Composites are constructed to define the wave patterns' structural characteristics. Their evolution is characterized by alternating cyclonic and anticyclonic equatorial anomalies that are linked to anomalous convective activity. Mid-latitude perturbations appear to contribute to the growth of new equatorial disturbances.

Variability within the cycle is examined relative to variations in the basic state vertical wind shear and zonal wind convergence or divergence in the region equator-10°N, 140°E-160°E. For the 50 cases in a basic state with easterly vertical wind shear and convergence, westward-moving waves propagate farther northwestward, wavelength contraction is greater, their orientation changes from east-west to southwest-northeast, and waves appear to be coupled with a Southern Hemisphere mid-latitude wave train. For the zonal wind divergence set, wave activity occurs farther eastward, circulations maintain a longer wavelength and more zonal orientation, and linkage with the Southern Hemisphere mid-latitudes is minimal.

A statistically-significant relationship exists between the 15-25 day wave phase and tropical cyclone activity. Formation frequency and preferred locations are modulated by the 15-25 day wave.

KEYWORDS: Tropical Cyclone Activity, Equatorial Rossby Waves, Large-scale Tropical Circulations
Setup is defined as the super-elevation of mean water surface within the surfzone and is caused by the reduction in wave momentum shoreward of the breaking point and compensating positive pressure gradient. Data are acquired north of Scripps Canyon on a gently sloping section of beach, which is homogenous in along-shore morphology, during the Nearshore Canyon Experiment, 2004. Pressure sensors are deployed both above and below the bed. Wave heights and radiation stress (wave-induced momentum) are calculated using linear theory transfer functions. Wave heights measured using pressure sensors in the water column have a positive bias of about five percent compared with the buried pressure sensors, which is presumed due to the Bernoulli effect of flow past the orifices. Predicted setup based on numerically solving the cross-momentum equation forced with the measured radiation stresses underestimates the observed setup by 40 percent in the mean. This is consistent with previous studies.

**KEYWORDS:** Oceanography, Nearshore, Setup, Radiation Stress, NCEX
USING DISCRETE EVENT SIMULATION TO ASSESS OBSTACLE LOCATION ACCURACY IN THE REMUS UNMANNED UNDERWATER VEHICLE

Timothy E. Allen-Lieutenant, United States Navy
B.S., University of Idaho, 1997
Master of Science in Operations Research-June 2004
Advisor: Arnold H. Buss, Modeling, Virtual Environments, and Simulation Institute
Second Reader: Susan M. Sanchez, Department of Operations Research

Navy personnel use the REMUS unmanned underwater vehicle to search for submerged objects. Navigation inaccuracies lead to errors in predicting the location of objects and result in increased search times for Explosive Ordinance Disposal (EOD) teams searching for the object post-mission. This thesis explores contributions to navigation inaccuracy using Discrete Event Simulation (DES) to model the vehicle’s navigation system and operational performance. The DES generates data used, in turn, to build three models. First, the probability of detection is modeled by a logit regression. Second, given that detection has occurred, the mean location offset is modeled by a linear regression. Third, the distribution of errors is shown to follow an exponential distribution. These three models enable operators to explore the impact of various inputs prior to programming the vehicle, thus allowing them to choose the best combination of vehicle parameters that minimize the offset error between the reported and actual locations.

KEYWORDS: Mine, Minefield, Simulation, Discrete Event Simulation, Simkit, Navigation

AN EXPLORATORY ANALYSIS OF VILLAGE SEARCH OPERATIONS

Mehmet Aydin-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1997
Master of Science in Operations Research-June 2004
Advisor: Thomas Lucas, Department of Operations Research
Second Reader: MAJ Lloyd Brown, USMC, TRADOC Analysis Center-Monterey

Following the Cold War, a new kind of threat emerged: terrorism became the most important threat used by individuals, organizations, and countries to reach their goals. Turkey has suffered from terrorism for years. In Turkey, the main logistic resource for the terrorist is the villages located in remote areas. A search operation is one of the techniques used to capture the terrorists. Five village search operations scenarios are developed based on a previous study done for the New Zealand Army and the author’s personal experiences. For this study, the agent-based model Map Aware Non-uniform Automata (MANA) is used. To investigate the effects of 16 variables, state-of-the-art Near Orthogonal Latin Hypercube Designs are used. With a personal computer and the computational capabilities of supercomputers run by Mitre for the Marine Corps Warfighting Lab (MCWL), approximately 15,000 runs are completed. In comparing the five scenarios, the significant factors affecting the outcome of a possible skirmish in search operations are the proficiency level of the soldiers, the employment of village guards, and the support of the local people to the terrorists. The results of the analysis suggest that the most important factor affecting the Blue casualties is the initial speed and synchronization of the Blue search unit entering the village, and the most important factor affecting the Red casualties is the Red Stealth.

ALIGNING SALARY EXPENSE AND WORKLOAD OUTPUT IN A COMPLEX MILITARY MEDICAL SYSTEM
Randy K. Bills-Lieutenant, United States Naval Reserve
B.S., Saint Francis College, 1993
M.A., Framingham State College, 1997
Master of Science in Operations Research-June 2004
Advisor: Samuel E. Buttrey, Department of Operations Research
Second Reader: LCDR Laura A. Barton, USN, Department of Operations Research

The National Naval Medical Center (NNMC), Bethesda, Maryland, set as a strategic goal the improvement of internal efficiency among its many clinical activities. Clinical services lacked the ability to improve their statistical process which relied on workload and expense data. Since the data systems had removed provider identifiers, it was impossible to produce data on provider productivity and efficiency.

Numerous efforts to improve the clinical staff’s efficiency were unsuccessful because of data integration limitations. Clinical service managers could not review their clinical service staff roster nor maintain the correct coding of personnel because they did not have access to the Standard Personnel Manpower System (SPMS).

The step-wise approach business plan described in this thesis outlines the steps to be taken to generate productivity and efficiency feedback reports. These reports provide the clinical managers the necessary performance metrics to determine on a monthly basis how effectively their clinical services were operating.

KEYWORDS: National Naval Medical Center, NNMC, Clinical Services, Standard Personnel Manpower System, SPMS

THE EFFECTS OF FATIGUE ON POSITION DETERMINATION AND COGNITIVE WORKLOAD USING A VISUAL AND 3-DIMENSIONAL AUDITORY DISPLAY
Eric L. Brown-Captain, United States Army
B.S., Morgan State University, 1995
Master of Science in Operations Research-June 2004
Advisor: Nita Lewis Miller, Department of Operations Research
Second Reader: LTC Eugene P. Paulo, USA, Department of Operations Research

This study compares the effects of a visual and a 3-dimensional auditory display on primary and secondary task performance, mood, and mental workload at incremental levels of sleep deprivation. It is based on a study conducted by the Army Research Laboratory, Cognitive Science Branch, Aberdeen, Maryland, from 12 Marines performing land navigational tasks in two helmet-mounted display (HMD) modes; visual and 3-dimensional auditory, for a 48 hour period. The results indicate that performance under sleep deprivation is significantly impacted in both modalities; however, performance in the primary task is more degraded in the 3-D auditory modality. Additionally, Marines are more likely to experience degraded performance in the secondary task with increased sleep deprivation. The recommendations address the need to design HMDs that will not overburden sensory channels and the concern for military leaders to understand the additional demands imposed on soldiers in an HMD environment.

KEYWORDS: Helmet Mounted Displays, Visual HMDs, Auditory HMDs, Sleep Deprivation, Cognitive Performance, Workload, Navigation

TOMAHAWK LAND ATTACK MISSILE PREDESIGNATION: OPTIMIZATION REVISITED
Ali Demir-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1997
Master of Science in Operations Research-June 2004
Advisor: Javier Salmeron, Department of Operations Research
Second Reader: Richard Rosenthal, Department of Operations Research

The Tomahawk Land-Attack Missile (TLAM) is the long-range precision weapon of choice in strike warfare against strategic targets for U.S. military forces. Predesignation is the process of determining
which ship or submarine will fire which TLAM missiles in support of an authorized attack upon specified targets. This thesis revisits the mathematical models and algorithms developed by previous NPS faculty and students to optimally conduct the allocation of TLAMs to firing units. All the problem specifications addressed by previous heuristic algorithms for the problem are incorporated and results are compared to those in publicly available test cases. It is shown that the models can be solved optimally in affordable time for most of the cases, and provisions are made to establish accurate bounds in the other cases.

**KEYWORDS:** Tomahawk Land-attack Missile, Long-range Precision Weapon, Predesignation, Optimization, Multi-objective Programming.

**ESTABLISHMENT OF MODELS AND DATA TRACKING FOR SMALL UAV RELIABILITY**

Marinos Dermentzoudis-Commander, Hellenic Navy  
B.S., Naval Academy of Greece, 1986  
Master of Science in Operations Research-June 2004  
Master of Science in Systems Engineering-June 2004  
Advisor: David Olwell, Department of Operations Research  
Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

This thesis surveys existing reliability management and improvement techniques, and describes how they can be applied to small unmanned aerial vehicles (SUAVs). These vehicles are currently unreliable and lack systems to improve their reliability. Selection of those systems, in turn, drives data collection requirements for SUAVs. Data collection requirements with proposed solutions are presented. This thesis also lays the foundation for a Navy-wide SUAV reliability program.

**KEYWORDS:** Reliability Improvement, FMECA, FRACAS, Reliability Growth

**OPTIMAL SENSOR ALLOCATION FOR A DISCRETE EVENT COMBAT SIMULATION**

Thomas Doll-Captain, German Armed Forces  
M.S., University of the Budeswehr-Munich, 1994  
Master of Science in Operations Research-June 2004  
Advisor: Matthew Carlyle, Department of Operations Research  
Second Reader: MAJ Donovan Phillips, USA, TRADOC Analysis Center-Monterey

The U.S. Army’s Future Force is being developed as a faster, lighter, more rapidly deployable alternative to the current force structure. The Future Force will feature a smaller in-theater footprint and require the ability to cover a larger area of the battle space with intelligence-gathering assets. To support this development, the Naval Postgraduate School and the Army’s Training Analysis Center (TRAC) Monterey began to conduct research in the area of allocation of Future Force sensor platforms.

A previous thesis developed the Sensor Allocation Model (SAM) for finding an appropriate mix and allocation strategy for organic Unit of Action sensors in a given threat scenario. The mix suggested by the model is robust to uncertainties in sensor performance and target quantity and location. SAM shows great promise for use as a screening tool in support of analysis of alternatives studies as well as in support of Army and joint war fighting experimentation. It also has potential for use as an operational decision support tool for unit commanders.

This thesis discusses three improvements to SAM. First, SAM has been translated into a programming language that can be easily implemented into any simulation environment. Second, it now contains more realistic constraints on sensor platform employment duration and distance. Third, the model estimates of sensor performance have been improved with a Probability Line of Sight model. Together, these improvements have greatly improved SAM’s usability.

**KEYWORDS:** Sensor Allocation Model, Sensor Platform Employment, Sensor Performance, Probability Line of Sight Model
Manning United States Army Reserve (USAR) units are fundamentally different from manning Regular Army (RA) units. A soldier assigned to a USAR unit must live within 75 miles or 90 minutes commute of his Reserve Center (RC). This makes reserve unit positioning a key factor in the ability to recruit to fill the unit. This thesis automates, documents, reconciles, and assembles data on over 30,000 zip codes, over 800 RCs, and over 260 military occupational specialties (MOSs), drawing on and integrating over a dozen disparate databases. This effort produces a single data file with demographic, vocational, and economic data on every zip code in America, along with the six year results of its RA, USAR, sister service recruit production, and MOS suitability for each of the 264 MOSs. Preliminary model development accounts for about 70% recruit production variation by zip code. This thesis also develops models for the top five MOSs to predict the maximum number of recruits obtained from a zip code for that MOS. Examples illustrate that zip codes vary in their ability to provide recruits with sufficient aptitude for technical fields. Two subsequent theses use those results. One completes the MOS models. The second uses the models as constraints in an optimization model to position RCs. An initial version of the optimization model is developed in this thesis. Together, the three theses provide a powerful tool for analysis of strategic-based optimal reserve force stationing.

KEYWORDS: Analysis, Regression, Statistics, Unit Stationing, Recruiting, Marketing, Data Manipulation, Data Mining, Database Management, Clementine Software

COST-CONSTRAINED PROJECT SCHEDULING WITH TASK DURATIONS AND COSTS THAT MAY INCREASE OVER TIME: DEMONSTRATED WITH THE U.S. ARMY FUTURE COMBAT SYSTEMS

Roger T. Grose-Major, Australian Army
B.S., University of New South Wales-Australia, 1992
Master of Science in Operations Research-June 2004
Advisor: Robert A. Koyak, Department of Operations Research
Second Reader: Gerald G. Brown, Department of Operations Research

Researchers optimize long-term project schedules subject to annual budget constraints, where the duration and cost of each task may increase as the project progresses. Initially, tasks are scheduled without regard to budgets and the project completion time is minimized. Treating the task durations as random variables, simulation is then used to describe the distribution of the project completion time. Next, the completion time under budget constraints with fixed task durations is minimized, where budget violations are tolerated albeit with penalties. Annual reviews are then introduced, which allow underway tasks to be delayed or monthly budgets to be increased. Estimates are obtained of the completion time of the project and its final cost under each of these scenarios. The U.S. Army Future Combat Systems (FCS) is used for illustration. FCS is a suite of information technologies, sensors, and command systems with an estimated acquisition cost of over $90 billion. The U.S. General Accounting Office found that FCS is at risk of substantial cost overrun and delay. Three schedule plans for FCS are analyzed to identify which can be expected to deliver the earliest completion time and the least cost.

KEYWORDS: Integer Linear Programming, Optimization, Project Management, Future Combat Systems, Cost Constrained Project Scheduling
AN EXPLORATORY ANALYSIS OF CONVOY PROTECTION USING AGENT-BASED SIMULATION
Matthew B. Hakola-Captain, United States Marine Corps
B.S., Radford University, 1993
Master of Science in Operations Research-June 2004
Advisor: Thomas Lucas, Department of Operations Research
Second Reader: David Schrady, Department of Operations Research

Recent insurgent tactics during Operation Iraqi Freedom (OIF) have demonstrated that coalition logistical convoys are vulnerable targets. This thesis examines the tactics, techniques, and procedures (TTPs) used in convoy operations in an attempt to identify the critical factors that lead to mission success. A ground convoy operation scenario is created in the agent-based model (ABM) Map Aware Non-uniform Automata (MANA). The scenario models a generic logistical convoy consisting of security vehicles, logistical vehicles, an unmanned aerial vehicle (UAV), and an enemy ambushing force. The convoy travels along a main supply route (MSR) where it is ambushed by a small insurgent force.

Military experience, judgment, and exploratory simulation runs are used to identify 11 critical factors within the created scenario. The data farming process and Latin Hypercube (LHC) experimental design technique are used to thoroughly examine the 11 factors. Using the 11 factors, 516 design points are created and data farmed over to produce 25,800 observations. Additive multiple linear regression is used to fit a model to the 25,800 observations. From the created scenario it is concluded that: convoy mission success may be determined by only a few factors; the actions of logistical vehicles are more critical than those of security vehicles; UAVs provide a statistically significant advantage; and ABMs coupled with LHCs and data farming are valuable tools for understanding complex problems.

KEYWORDS: Convoy Operations, Agent-based Models, Agent-based Distillations, MANA, Project Albert, Design of Experiment, Latin Hypercube, Additive Multiple Linear Regression

AN ANALYSIS OF THE IMPACT OF CHANGES IN THE OFFICER EDUCATION SYSTEM ON THE ARMY’S TRANSIENT, HOLDEE, AND STUDENT ACCOUNT
Arthur J. Hoffmann, Jr.-Major, United States Army
B.A., Hofstra University, 1987
Master of Science in Operations Research-June 2004
Advisor: Samuel E. Buttrey, Department of Operations Research
Second Reader: Matthew G. Boensel, Department of Systems Engineering

The United States Army is making changes in the officer education system (OES) for Second Lieutenants to Majors. These changes affect the size of Transient, Holdee, and Student account (THS). The current Officer Basic Course changes to a two-phased system called Basic Officer Leadership Course (BOLC II and III). A twenty-week Captains’ Career Course replaces the CCC and Combined Arms and Service Staff School (CAS3). Currently, Command and General Staff College (CGSC), where 50% of a year group attends resident CGSC, shifts to a two-phased approach with a Common Core Course and a Career Field Qualification Course. This thesis includes an Excel simulation model producing monthly predictions for six years for officers in THS account based on schooling. Assignments are Permanent Change of Station (PCS), Temporary Duty (TDY) Enroute, or TDY and Return. Therefore, if 30% of majors attend OES as a PCS or TDY Enroute, the THS account sees a man-year increase of between 166 and 552 personnel. For CCC, if 30% of captains attend CCC as PCS/TDY Enroute, THS shows a man-year decrease of between 812 and 819. When the new BOLC education system was simulated, the THS account showed a man-year increase of between 172 and 242 when compared to the current OBC.

KEYWORDS: Spreadsheet Modeling, Simulation, Manpower, Army Personnel, Officer Education System
AN INTEGER LINEAR PROGRAM TO SCHEDULE AN ARMY INSTALLATION’S MANEUVER TRAINING
Fatih Kasimoglu-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1997
Master of Science in Operations Research-June 2004
Advisor: Robert F. Dell, Department of Operations Research
Second Reader: David Ollwell, Department of Operations Research

This thesis develops an integer linear program called Model to Schedule Army Maneuver Training (MSAMT) to schedule an Army installation’s maneuver training. Researchers demonstrate MSAMT using a data set containing 261 platoon-level, 67 company-level, and 18 battalion-level units, and seven major training areas located at Fort Hood, Texas. Using a typical near-term planning horizon from six to eight weeks, MSAMT schedules daily training for a randomly selected set of the stationed units and training requirements. For a six-week time period and almost 65% (63 platoons, 16 companies, and five battalions) of the units, there are 151 platoon-level, 51 company-level, and 11 battalion-level required tasks of which MSAMT can schedule 93%. When the subset of units is increased to 80% (75 platoons, 20 companies, six battalions), there are 187 platoon-level, 62 company-level, and 11 battalion-level tasks of which MSAMT can schedule only 85%. Maintaining the 80% unit level but having an eight-week period increases required training achieved to 94%. Such results can help determine the ability of an Army installation to satisfy training requirements of its stationed units, as well as identify a shortage or excess in available training land. It can show the training impact of changing the quantity of units at an installation and thereby aid in base realignment and closure decisions.

KEYWORDS: Operations Research, Integer Linear Programming, Optimal Stationing of Army Forces, Maneuver Training Scheduling, Optimal Usage of Army Training Lands

AN ANALYSIS OF THE EFFECT OF COMMISSIONING SOURCES ON RETENTION AND PROMOTION OF U.S. ARMY OFFICERS
Zafer Kizilkaya-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1999
Master of Science in Operations Research-June 2004
Master of Science in Information Technology Management-June 2004
Advisors: Samuel E. Buttrey, Department of Operations Research
Daniel R. Dolk, Department of Information Sciences
Second Reader: Kathryn Kocher, Graduate School of Business and Public Policy

This thesis analyzes the effects of commissioning sources on the retention and promotion of U.S. Army officers.

The data in this thesis were taken from the Active Duty Military Master File, with separate data sets for cohorts commissioned from 1981 through 2001. Three logistic regression models are described: retention to the grade of O-4, promotion to O-4, and promotion to O-5.

It is concluded that Academy graduates have the lowest retention rates, whereas Officer Candidate School (OCS) graduates have the highest retention rates. Among male officers, retention rates are higher for Reserve Officer Training Corps (ROTC) graduates than for those with direct appointments; among female officers, retention rates are higher for direct appointments than ROTC graduates. The promotion to O-4 model indicates that the effect of commissioning source is different within gender, race, and marital status groups. The results of the promotion to O-5 model contrasts with those of the O-4 models. Academy graduates are more likely to be promoted to Lieutenant Colonel than those from other sources, followed by ROTC graduates, and then direct appointments.

The effects of the Army's reduction in force ("drawdown") between 1989 and 1996 are not accounted for in this thesis, as they cannot be modeled with the data at hand.

KEYWORDS: U.S. Army, Officer Commissioning Sources, Officer Career Development, Retention, Promotion, Logistic Regression
AN ANALYSIS OF DEGRADED COMMUNICATIONS IN THE ARMY’S FUTURE FORCE
Joseph M. Lindquist-Captain, United States Army
B.S., Milwaukee School of Engineering, 1995
Master of Science in Operations Research-June 2004
Advisor: Thomas Lucas, Department of Operations Research
Second Reader: MAJ Lloyd Brown, USMC, TRADOC Analysis Center-Monterey

The U.S. Department of Defense (DoD) is currently pursuing the most comprehensive transformation of its forces since the early years of WWII. This transformation is a holistic approach to update both the equipment with which the forces will fight conflicts and the way in which they will fight. This transformation relies heavily on fully networked air, ground, and space based platforms. While many experts agree that in the course of the next ten years, communications equipment will emerge to support the networking of these systems, much uncertainty remains on how operations will be affected if the technology does not mature enough to meet expectations. This research shows that even a 25 percent degradation in communications range could pose significant challenges for this future force. Additionally, even small delays (latencies greater than one minute) and constraints on network throughput can increase the future force casualties and the duration of battle.

While the end result in all analyses shows that Future Combat Systems (FCS) is a superior force with the same battle end state, the cost of that victory depends, at least in part, on effective communications.

KEYWORDS: Agent-based Models, MANA, Project Albert, Latin Hypercube, Design of Experiment, Communications, FCS, Future Force, Network Centric Warfare, Objective Force

AGGREGATE MODELS FOR TARGET ACQUISITION IN URBAN TERRAIN
Joseph A. Mlakar-Captain, United States Marine Corps
B.S., Carnegie-Mellon University, 1998
Master of Science in Operations Research-June 2004
Master of Science in Applied Mathematics-June 2004
Advisors: LTC Thomas M. Cioppa, USA, Department of Operations Research
Craig W. Rasmussen, Department of Applied Mathematics
Second Reader: MAJ Donovan Phillips, USA, TRADOC Analysis Center-Monterey

High-resolution combat simulations that model urban combat currently use computationally expensive algorithms to represent urban target acquisition at the entity level. While this may be suitable for small-scale urban combat scenarios, simulation run time can become unacceptably long for larger scenarios. Consequently, there is a need for models that can lend insight into target acquisition in urban terrain for large-scale scenarios in an acceptable length of time.

This research develops urban target acquisition models that can be substituted for existing physics-based or computationally expensive combat simulation algorithms, and result in faster simulation run time with an acceptable loss of aggregate simulation accuracy. Specifically, this research explores: 1) the adaptability of probability of line of sight estimates to urban terrain; 2) how cumulative distribution functions can be used to model the outcomes when a set of sensors is employed against a set of targets; 3) uses for Markov Chains and Event Graphs to model the transition of a target among acquisition states; and 4) how a system of differential equations may be used to model the aggregate flow of targets from one acquisition state to another.

KEYWORDS: Probability of Line of Sight, Line of Sight, Urban Target Acquisition, Cumulative Distribution Functions, Markov Chains, Systems of Differential Equations
AN ANALYSIS OF THE INTEGRATED MECHANICAL DIAGNOSTICS HEALTH AND USAGE MANAGEMENT SYSTEM ON ROTOR TRACK AND BALANCE
Mark S. Revor-Captain, United States Marine Corps
B.S., United States Naval Academy, 1994
Master of Science in Operations Research-June 2004
Advisors: Lyn R. Whitaker, Department of Operations Research
Arnold H. Buss, Modeling, Virtual Environments, and Simulation Institute
Second Reader: Samuel E. Buttrey, Department of Operations Research

This thesis is concerned with the operational benefit of the Integrated Mechanical Diagnostics Health and Usage Management Systems (IMD HUMS) rotor track and balance (RTB) functionality. The questions addressed are whether there is a savings in flight hours expended on functional check flights (FCF's) when compared to present practices, if there is a reduction in directed maintenance man-hours (DMMH) spent on maintenance related to the rotor system, and the impact on Operational Availability. Experiments are conducted using a discrete event simulation model of squadron flight operations and organizational level maintenance. The simulation is generic and can be used in the analysis of other helicopters. Input parameters governing the distributions of maintenance action inter-arrival times are estimated from Naval Aviation Logistics Data Analysis (NALDA) databases and squadron experiences on such systems. The analysis suggests that flight hours spent in FCF are dependent upon vibration growth rate, an unknown quantity, and the maintenance policy for rotor smoothing. Directed maintenance man-hours decrease with increasing numbers of IMD HUMS-configured aircraft, and further gains are achieved with a maintenance policy suited to a continuous monitoring system.


MODELING HOW INDIVIDUAL ENTITIES REACT TO INDIRECT FIRE
D. Brent Streater-Captain, United States Army
B.S., United States Military Academy, 1995
Master of Science in Operations Research-June 2004
Advisor: LTC Eugene P. Paulo, USA, Department of Operations Research
Second Reader: Thomas Lucas, Department of Operations Research

Current Army models and simulations provide limit representation of the actions and behaviors of the individual combatant (Soldier, Sailor, Marine, or Airman). As the Army transforms into the Future Force, more emphasis is being placed on modeling the actions and behaviors of the individual combatant. The Training and Doctrine Command Analysis Center-Monterey has initiated the Individual Combatant Research Project. One research area is modeling how individual entities react to indirect fire, which is the focus of this thesis. From a study of both historical examples and current U.S. Army doctrine, the input factors and responses are derived. The most significant input factors are selected and a general model to represent this phenomenon is derived. From the general model, a specific model is derived and implemented as a behavior rule using the Combined Arms Analysis Tool for the 21st Century, CXXI. In order to determine the effectiveness of the model, the face validation method is used. Data analysis consisted of a two-sample t-test, a Mann-Whitney test, and a two-way analysis of variance. From the analysis, it was concluded that implementation of the model in CXXI was an improvement that makes CXXI more realistic and functional.

KEYWORDS: Modeling, Algorithm, Behavior Rules, Indirect Fire, Combined Arms Analysis Tool for the 21st Century
DEVELOPMENT AND EVALUATION OF AN AUTOMATED DECISION AID FOR RAPID RE-TASKING OF AIR STRIKE ASSETS IN RESPONSE TO TIME SENSITIVE TARGETS
Paul R. Weaver-Major, United States Marine Corps
B.S., State University of New York-Maritime College, 1992
Master of Science in Operations Research-June 2004
Advisors: Richard Rosenthal, Department of Operations Research
Thomas Hoivik, Department of Operations Research
Second Reader: LCDR Kelly Cormican, USN, Department of Operations Research

This thesis addresses the problem of optimally re-assigning strike aircraft to targets in response to the emergence of “pop-ups” or time-sensitive targets. The first part of this thesis develops an automated decision aid to rapidly revise the current air tasking order (ATO), in order to maximize achievement of target destruction goals (weighted by target priorities), minimize attrition risk to employed assets, and disrupt the current ATO as little as possible. The second part of the thesis develops a detailed test and evaluation plan to conduct a comparison of two competing automated decision aids and the current manual reassignment methods. Critical operational issues, measures of effectiveness, and measures of performance are developed to fully evaluate operational performance. The time-sensitive-targeting decision aid is tested and validated during major air strike live exercises at Marine Aviation Weapons and Tactics Squadron One. Careful measurements comparing the re-taskings recommended by the decision aid against actual decisions demonstrate that in every case the model's solutions are of better or equal quality, maximize combat asset utilization, and are achieved significantly faster.

KEYWORDS: Time Sensitive Targeting, Optimization, Test and Evaluation, Operations Research

ANALYZING THE EFFECTS OF URBAN COMBAT ON DAILY CASUALTY RATES
Hakan Yazilitas-First Lieutenant, Turkish Army
B.S., Turkish Military Academy, 1998
Master of Science in Operations Research-June 2004
Advisor: Samuel E. Buttrey, Department of Operations Research
Second Reader: LTC Saverio Manago, USA, Department of Operations Research

This study explores whether the attacker’s daily casualty rate (DCR) changes according to the terrain. The data set is a part of a larger database, the Division Level Engagement Database from the Dupuy Institute. Data is available on 253 battles, 96 of which occurred in urban areas. All the engagements are selected from the European Theater of Operation (ETO) in World War II. The available data set contains measurements about the battles, such as initial strengths, daily casualties, terrain, front width, linear density, attacker’s and defender’s country, and armor losses. A linear regression model is constructed to predict outcomes of similar engagements and to see the effect of each variable. It is concluded that the attacker’s daily casualty rate is, on average, lower in urban operations. Terrain and force ratio are the most effective drivers of the daily casualty rate. In addition, allied forces (U.S., U.K., and Canada) had a different approach to military operations on urban terrain than Soviet and German forces. The Allies used extensive combat power in urban operations.

KEYWORDS: Casualty Rate, Linear Regression, MOUT, Urban Warfare
Modeling fatigue, sleepiness, and performance is of significant interest to military leaders because military operations often provide limited sleep opportunities for many individuals. The ANAM Readiness Evaluation System (ARES) Commander Battery is under consideration as a quick, inexpensive method of testing a crewmember’s level of functioning. This thesis analyzes data collected during a previous field fatigue study conducted at the Naval Officer Indoctrination School (OIS) in Newport, Rhode Island. Linear mixed-effects models are developed and ARES data are evaluated for how they vary across participants, testing sessions, and time of day.

**KEYWORDS:** ARES, FAST, SAFTE, Alertness, ANAM, Sleep Regulation, Sleep Deprivation, Sleep Inertia, Sleep Debt, Performance, Linear Mixed Effects Model
Child and Langmuir introduced a solution to space charge limited emission in an infinite area planar diode. The solution follows from starting with Poisson’s equation, and requires solving a non-linear differential equation. This approach can also be applied to cylindrical and spherical geometries, but only for one-dimensional cases. By approaching the problem from Coulomb’s law and applying the effect of an assumed charge distribution, it is possible to solve for space charge limited emission without solving a non-linear differential equation, and to limit the emission area to two-dimensional geometries. Using a Mathcad worksheet to evaluate Coulomb’s law, it is possible to show correlation between the solution derived by Child and Langmuir and Coulomb’s law.

KEYWORDS: Space Charge Limited Emission, Coulomb’s Law
High Frequency (HF) radar backscatter instruments are under development and testing in the marine science and defense science communities for their abilities to remotely sense surface parameters in the coastal ocean over large areas. In the Navy context, the systems provide real-time mapping of ocean surface currents and waves critical to characterization and forecasting of the battlespace environment. In this study, HF radar, aircraft, and satellite information are used to investigate and describe surface currents in Monterey Bay, California, for a period of ten months, from June 1, 2003 to March 31, 2004. A network of five Coastal Ocean Dynamics Application Radar (CODAR)-type HF radar instruments measure hourly surface currents over the Bay. The measurements are averaged over one-hour intervals and total surface velocities are mapped on a grid in the Monterey Bay. From the M1 Buoy located in the middle of the Bay, an uninterrupted time series of wind intensity and direction is obtained for the whole period. Major upwelling events are observed during the period of June 14 to June 27, July 4 to July 19, August 8 to August 18 and other upwelling events are observed until late October. These periods of upwelling favorable winds with durations of 10 to 20 days are common during summer. Often they are interrupted by periods of relaxation state of just a few days as the winds veer to the northwest or northeast. Cyclonic circulation cells are developed on shore during upwelling conditions and an anticyclonic circulation in the middle of the Bay is observed when the wind shifts to the southwest, producing a strong flow out of the Bay close to the coastline off Point Pinos. Downwelling conditions are much less common than upwelling, with occurrences during winter and early fall storms, with events lasting between two to five days. When the wind blows to the northeast with an intensity of 4 m/s or more for more than 12 hours, a well developed anticyclonic gyre forms in the middle of the Bay. This is associated with a strong current, 35 to 40 cm/s, which flushes out in the southern part of the Bay close to the coast off Point Pinos. This flow reverses when the winds veer to the southwest and enter into the Bay with less intensity.

KEYWORDS: High Frequency Radar, Upwelling, Monterey Bay Circulation, Surface-current Maps, Relaxation Periods

CALIBRATION AND VALIDATION OF HIGH FREQUENCY RADAR FOR OCEAN SURFACE CURRENT MAPPING
Kyung Cheol Kim-Lieutenant Commander, Republic of Korea Navy
B.S., Republic of Korea Naval Academy, 1993
Master of Science in Physical Oceanography-June 2004
Advisor: Jeffrey Paduan, Department of Oceanography
Second Reader: Steven R. Ramp, Department of Oceanography

High Frequency (HF) radar backscatter instruments are being developed and tested in the marine science and defense science communities for their abilities to sense surface parameters remotely in the coastal ocean over large areas. In the Navy context, the systems provide real-time mapping of ocean surface currents and waves critical for characterizing and forecasting the battle space environment.

In this study, the performance of a network of four Coastal Ocean Dynamics Application Radar (CODAR) SeaSonde HF radars, using the Multiple Signal Classification (MUSIC) algorithm for direction finding, is described for the period between July to September 2003. Comparisons are made in Monterey Bay.
PHYSICAL OCEANOGRAPHY

Bay with moored velocity observations, with four radar baseline pairs, and with velocity observations from sixteen drifter deployments.

All systems measure ocean surface current and all vector currents are translated into radial current components in the direction of the various radar sites. Measurement depths are ~1 m for the HF radar-derived currents, 12 to 20 m for the ADCP bin nearest to the surface at the M1 mooring site, and ~8 m for the drifter-derived velocity estimates.

Comparisons of HF radar-M1 mooring buoy, HF radar-HF radar (baseline), and HF radar-drifter data yield improvements of −1.7 to 16.7 cm/s rms differences and −0.03 to 0.35 correlation coefficients when measured antenna patterns are used. The mooring comparisons and the radar-to-radar baseline comparisons indicate angular shifts of 10° to 30° for radial currents produced using ideal antenna patterns and 0° to 15° angular shifts for radial currents produced using measured patterns. The comparisons with drifter-derived radial currents indicate that these angular biases are not constant across all look directions, even though the local antenna pattern distortions are taken into account through the use of measured antenna patterns. In particular, data from the SCRZ and MLNG radar sites show varied pointing errors across the range of angles covered.

**KEYWORDS:** HF Radar, Ocean Surface Current, Calibration, MUSIC Algorithm
The Marine Corps is fielding the Medium Tactical Vehicle Replacement (MTVR) Truck as a replacement for its aging fleet of five-ton cargo trucks. The MTVR is an Acquisition Category II program that was previously a multi-service Army-Marine Corps program. The purpose of this thesis is to examine the effectiveness of having an Army Product Office execute a Marine Corps program. The study analyzes the effectiveness of the timing of the program’s transition from the Army to the Marine Corps. A detailed literature search, as well as information gathered from attending various in-progress reviews (IPRs) and conducting interviews with program officials and contractors, provide the basis for the in-depth background study presented. Analysis of the data gathered lead to a justification for multi-service managed programs as well as to recommendations on the timing of the MTVR program transition.

**KEYWORDS:** MTVR Truck, Acquisition Category II, ACAT, Marine Corps’ Medium Tactical Vehicle Replacement, High Mobility Multi-purpose Wheeled Vehicle, HMMWV, Logistics Vehicle System, LVS, Light Armored Vehicle, LAV
In 1991, shortly after the combat portion of the Gulf War, key military and government leaders identified an urgent requirement for an accurate on-site tool for analysis of chemical, biological, and nuclear hazards. Defense Nuclear Agency (now Defense Threat Reduction Agency, DTRA) was tasked with the responsibility of developing a software tool to address the requirement. Based on extensive technical background, DTRA developed the Hazard Prediction Assessment Capability (HPAC). For over a decade, HPAC addressed the users requirements through on-site training, exercise support, and operational reachback. During this period, the HPAC code was iteratively improved but the basic architecture remained constant until 2002. In 2002, when the core requirements of the users started to evolve into more net-centric applications, DTRA began to investigate the potential of modifying their core capability into a new design architecture. This thesis documents the requirements, analysis, and architectural design of the newly prototyped architecture, Integrated Weapons of Mass Destruction Toolset (IWMĐT). The primary goal of the IWMĐT effort is to provide accessible, visible, and shared data through shared information resources and templated assessments of chemical, biological, radiological, nuclear, and high yield explosive (CBRNE) scenarios. This effort integrates a collection of computational capabilities as server components accessible through a web interface. Using the results from this thesis, DTRA developed a prototype of the IWMĐT software. Lessons learned from the prototype and suggestions for follow-on work are presented in this thesis.

**KEYWORDS:** WME, WMD, Chemical, Biological, Nuclear, Hazard Prediction, Software Tools, Distributed, Client-server, SOAP, XML, JAVA, DTRA, HPAC, IMEA, INCA, Targeting, Web-services, J2EE, IWMĐT

**CONVERGENCE OF THE NAVAL INFORMATION INFRASTRUCTURE**

James A. Knoll-Lieutenant Commander, United States Navy
B.S., Campbell University, 1991
B.S., United States Naval Academy, 1993
Master of Science in Software Engineering-June 2004
Advisor: William Ray, Department of Computer Science
Second Reader: David Floodeen, Department of Computer Science

Converging voice and data networks has the potential to save money and is the main reason Voice over Internet Protocol (VoIP) is quickly becoming mainstream in corporate America. The potential VoIP offers to more efficiently utilize the limited connectivity available to ships at sea makes it an attractive option for the Navy. This thesis investigates the usefulness of VoIP for the communications needs of a unit level ship. This investigation begins with a review of VoIP and then examines the ship to shore connectivity for a typical unit level ship. An Objective Modular Network Testbed in C++ (OMNeT++) model is developed and used to examine the issues that affect implementing VoIP over this type of link. Results are presented.

**KEYWORDS:** Voice over IP, VoIP, ADNS, OMNET++, Convergence, Satellite Communications, Networks, Simulation
A METHOD FOR FINDING COMMON ATTRIBUTES IN HETEROGENEOUS DOD DATABASES
Hamza A. Zobair-DoD Civilian
B.S., Lawrence Technology University, 1990
Master of Science in Software Engineering-June 2004
Advisor: Valdis Berzins, Department of Computer Science
Second Reader: CAPT Paul Young, USN, United States Naval Academy

Traditional database development has been done for a specific, self-contained purpose with no plan to share or merge the data with other databases in the future. As these systems have matured, users have realized a requirement exists to share their data.

Finding common attributes among databases is a time consuming task. However, it is one that is necessary as more and more corporations and agencies consolidate operations. In terms of the Department of Defense (DoD), the requirement to consolidate systems has come about as the various data systems used by DoD agencies and our allies need to communicate with each other for a well-coordinated operation. One alternative for achieving the desired interconnectivity is to specify the requirement for interoperability in new systems. A more practical, less costly process is to merge existing systems and consolidate the common components. This thesis proposes a process for consolidating portions of data dictionaries of two existing databases. The proposed method uses commercial-off-the-shelf software to find common attributes between multiple databases and represents an improvement in accuracy and time over previous methods.

KEYWORDS: Data Matching, Merging Databases
NPSAT1 will be launched as a secondary payload on the Evolved Expendable Launch Vehicle (EELV) Atlas V. The Atlas V will provide a medium lift capability in the EELV class of launch vehicles. NPSAT1 will be mated to the Atlas V using the EELV Secondary Payload Adapter (ESPA). The design and operations of NPSAT1 will require that the space vehicle pose no hazards to ground support equipment, personnel, the launch vehicle, or other payloads. Potential hazards include structural failure, inadvertent deployment of antennas or other mechanisms, inadvertent radio frequency emissions, and other hazards.

The scope of this thesis is to assess the safety risks associated with NPSAT1 for all activities occurring at the launch site through orbit insertion. This includes ground testing at the integration site as well as in-flight operations prior to and shortly after separation from the launch vehicle. All hazards associated with NPSAT1 are to be enumerated and assessed for criticality. Hazard mitigation is to be presented preferably through subsystem design but may also be performed through operations.

**KEYWORDS:** NPSAT1, MSPSP, Missile System Prelaunch Safety Package
ESTABLISHMENT OF MODELS AND DATA TRACKING FOR SMALL UAV RELIABILITY

Marinos Dermentzoudis-Commander, Hellenic Navy
B.S., Naval Academy of Greece, 1986
Master of Science in Operations Research-June 2004
Master of Science in Systems Engineering-June 2004
Advisor: David Olwell, Department of Operations Research
Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

This thesis surveys existing reliability management and improvement techniques, and describes how they can be applied to small unmanned aerial vehicles (SUAVs). These vehicles are currently unreliable and lack systems to improve their reliability. Selection of those systems, in turn, drives data collection requirements for SUAVs. Data collection requirements with proposed solutions are presented. This thesis also lays the foundation for a Navy-wide SUAV reliability program.

KEYWORDS: Reliability Improvement, FMECA, FRACAS, Reliability Growth

REAL-TIME DATA ACQUISITION AND PROCESSING OF THE MAGNETIC, ANGULAR RATE AND GRAVITY (MARG) SENSOR

Ioannis R. Saliaris-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1996
Master of Science in Electrical Engineering-June 2004
Master of Science in Systems Engineering-June 2004
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

This research involves the development of a human-body motion tracking system constructed with the use of commercial off-the-shelf (COTS) components. The problem to be solved is that the data from the motion tracking sensors must be transmitted wirelessly in real time from a microcontroller to a server computer. Due to the fact that the microcontroller does not support a standard operating system (OS), widely used Personal Computer Memory Card International Association (PCMCIA) cards or Universal Serial Bus (USB) wireless modules cannot be used. The wireless communication module chosen for this purpose is the DPAC Technologies’ Airborne wireless module, a highly integrated 802.11b module that can be easily integrated with the microcontroller.

The evaluation of the module is completed in four stages. The first part is to initiate communication with the DPAC module. The second part is to establish communication between the DPAC module and a TCP server. The third part is to establish communication between the microcontroller and the DPAC module. The fourth part is to increase the baud-rate to the desired high value of 230,400 bps.

The evaluation result indicates that the DPAC Airborne wireless 802.11b module meets the wireless communication requirements of the motion tracking system.

KEYWORDS: MARG III Sensor, Control Interface Unit, CIU, Microcontroller, RS232, UART, PCMCIA, USB, Wireless Communication, 802.11, 802.11b, WiSER 2400, DPAC Airborne
MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY

TRANSFORMATIONAL COMMUNICATIONS ARCHITECTURE FOR THE UNIT OPERATIONS CENTER (UOC); COMMON AVIATION COMMAND AND CONTROL SYSTEM (CAC2S); AND COMMAND AND CONTROL ON-THE-MOVE NETWORK, DIGITAL OVER-THE-HORIZON RELAY (CONDOR)
Gilbert O. Garcia-Captain, United States Marine Corps
B.S., The Citadel, 1995
Master of Science in Systems Technology-June 2004
David C. Joseforsky-Captain, United States Marine Corps
B.S., United States Naval Academy, 1997
Master of Science in Systems Technology-June 2004
Advisors: William G. Kemple, Department of Information Sciences
Brian Steckler, Department of Information Sciences

The purpose of this research is to introduce a Transformational Communications Architecture for the Unit Operations Center (UOC); Common Aviation Command and Control System (CAC2S); and Command and Control On-the-Move Network, Digital Over-the-Horizon Relay (CoNDOR). The methodology is to conduct field tests with government contractors and private vendors in order to demonstrate the capabilities of each wireless technology researched. These wireless technologies, Free Space Optics (FSO), Microwave, 802.16, 802.11b over SecNet-11, Orthogonal Frequency Division Multiplexing (OFDM), Broadband Satellite, INMARSAT, and Iridium, have the potential of being implemented in the transformational communications architecture for intra-nodal and inter-nodal links for UOC and CAC2S, as well as the CoNDOR communications architecture. The goal of this research is to introduce different technologies that offer more flexibility, mobility, and capability at the tactical level, giving the Marine Corps the tactical wireless edge. Throughout this research, the focus revolved around testing equipment and network configurations in an IP network. Special consideration is given to wireless issues for the UOC, CAC2S, and CoNDOR, which could improve line-of-sight, beyond line-of-sight, and over-the-horizon communications for each program. These new technologies will transform communications in the United States Marine Corps for the 21st century.

KEYWORDS: UOC, CAC2S, CoNDOR, FSO, 802.11b, SecNet-11, 802.16, OFDM, Microwave, SATCOM, INMARSAT, IRIDIUM, KG-235, LOS, BLOS, OTH, Communications On-the-Move, FORCEnet

MODEL OF THE U.S. CENTCOM JOINT TARGETING ARCHITECTURE: DEVELOP TARGETS
David G. Germakian-Ensign, United States Naval Reserve
B.A., Harvard University, 2003
Master of Science in Systems Technology-June 2004
Derek C. Jaskowiak-Ensign, United States Naval Reserve
B.S., United States Naval Academy, 2003
Master of Science in Systems Technology-June 2004
Advisor: John S. Osmundson, Department of Information Sciences
Second Reader: William G. Kemple, Department of Information Sciences

This thesis was conducted in support of a larger research effort to improve the United States Central Command’s (U.S. CENTCOM) joint targeting architecture. The ultimate goal of this research project is to develop a working Extend model, which accurately describes CENTCOM’s targeting process, in order to assist the Joint Intelligence Interoperability Board (JIIB) in their JIIB Systems Baseline Assessment (JSBA)
for fiscal year 2004, as well as for all subsequent JSBAs. This thesis explains the advantages of using a systems engineering approach to developing a process model, and ultimately an Extend model. It provides a brief description of the entire CENTCOM targeting cycle; however, it focuses on the “Develop Targets” activity. The two major products of this research effort are an accurate and detailed paper model using Microsoft Visio, and a baseline Extend model of the “Develop Targets” activity. The Extend model and its capabilities are described in full detail and will serve as the foundation from which the other activities in this targeting process will be modeled. Additionally, recommendations for future improvement of the model are explained.

KEYWORDS: Extend, Targeting Architecture, CENTCOM, JIIB, JSBA, Model, Joint, JFMCC, JFSOCC, JFACC, DJFLCC, JFC, JICCENT

CONDUCT AND ASSESSMENT OF A2C2 EXPERIMENT 9 AND IDEAS TO CONSIDER FOR FUTURE EXPLORATION
Nelson Douglas Heintz-Lieutenant, United States Navy
B.S., Hawaii Pacific University, 1998
Master of Science in Systems Technology-June 2004
David K. Ng-Lieutenant, United States Navy
B.S., Columbia University, 1995
Master of Science in Systems Technology-June 2004
Advisor: William G. Kemple, Department of Information Sciences
Second Reader: Susan G. Hutchins, Department of Information Sciences

The ability of an organization to adapt its structure to changing dynamic requirements can provide for increased effectiveness and efficiency. A better understanding of the factors that affect adaptation capabilities within an organization can facilitate implementation of changes to better fit the organization to the mission.

Experiment 9, conducted for the Office of Naval Research’s (ONR) Adaptive Architectures for Command and Control (A2C2) research program, provided insight into the decision making process of a small group, given changes in a scenario to prompt need for change. The experiment also provided insight into the challenges faced by an organization in the process of adaptation and factors that affect the willingness and the need for adaptation.

This thesis examines how differences of emphasis within the training environment itself may affect an organization's willingness to adapt to changing circumstances. This thesis proposes changes to future experiments, focusing efforts on making cues more apparent to the test subject. This thesis also suggests modifications to the data collection system to enhance post experiment analysis.

KEYWORDS: A2C2, Adaptive Architectures for Command and Control Experiment 9, Adaptive Organizations

MISSION TASKING OF UNMANNED VEHICLES
Jada E. Johnson-Ensign, United States Navy
B.S., United States Naval Academy, 2003
Master of Science in Systems Technology-June 2004
Advisor: Dan C. Boger, Department of Information Sciences
Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

Unmanned Vehicles (UVs) are expected to be an integral part of the U.S. Navy’s expeditionary and carrier strike groups and are quickly being integrated into maritime operations. Command and control issues must be resolved, however, in order to utilize unmanned systems as intelligence, surveillance, and reconnaissance assets. The purpose of this research was to assess the current doctrine of mission tasking with respect to tactical unmanned vehicles and determine a method for effectively tasking these systems.

The problem was analyzed by applying the factors of METT-T: mission, enemy, terrain, and weather, troops and support available, and time available to UV-enabled maritime missions. The analysis identified specific implications for unmanned vehicles and emphasized important considerations for tasking and
allocating UVs. METT-T analyses generally result in courses of action; however, tasking is a command and control issue, and therefore, four organizational structures emerge for tasking UVs.

A significant finding of this study is that the current doctrinal framework of the composite warfare commander’s concept can support tasking unmanned vehicles but requires revision to effectively address UV allocation issues.

KEYWORDS: Command and Control, Mission Tasking, Unmanned Vehicles, Unmanned Surface Vehicles, Unmanned Aerial Vehicles, Unmanned Undersea Vehicles

INFORMATION EXCHANGE ARCHITECTURE FOR INTEGRATING UNMANNED VEHICLES INTO MARITIME MISSIONS
Aaron L. Woolsey-Ensign, United States Navy
B.S., University of Southern California, 2003
Master of Science in Systems Technology-June 2004
Advisor: Orin Marvel, Department of Information Sciences
Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

The United States Navy is committed to implementing and using unmanned vehicles (UVs). Battle groups have deployed and will continue to deploy with UVs because of their potential effectiveness. However, current UV doctrine does not set forth a standardized set of techniques and procedures for UV information exchange during maritime missions. The focus of this study is to analyze the structure of information flow for unmanned systems and to suggest an exchange architecture to successfully inform and build decision maker understanding based on data from UVs in support of these missions. Through analysis of the knowledge-information-data (KID) model and definition of high-level functions and tasks created from fleet input, this thesis develops an Integration Definition for Function Modeling (IDEF0) and Program Evaluation and Review Technique (PERT) representation. It outlines tasks and roles for successfully accomplishing information exchange from UV payload sensors to tactical decision makers. The study concludes with suggested measures of effectiveness and performance to determine the strength and validity of the architecture.

KEYWORDS: C4ISR System Architecture, Distributed Sensors, IDEF0, Information Exchange Architecture, KID Model, Maritime Missions, PERT Chart, Recognized Maritime Picture, Remote Sensors, RMP, Understanding Flow, Unmanned Vehicles, UV
IS THE PHILIPPINES PROFITING FROM THE WAR ON TERRORISM?
Robin L. Bowman-Captain, United States Air Force
B.A., University of California-Berkeley, 1998
Master of Arts in National Security Affairs-June 2004
Advisors: Gaye Christoffersen, Department of National Security Affairs
Vali Nasr, Department of National Security Affairs

The Philippines is one of the foremost supporters of the Global War on Terrorism (GWOT), responding to the call for robust counter-terrorism (CT) measures through policy and legislation, intelligence-sharing, and military and law enforcement cooperation. As a strategic ally, the United States has renewed political and security relations with Manila, strained since the base closures in 1991, and Washington has given hundreds of millions of dollars in military and economic aid since 9/11. However, instead of improving the country’s CT capabilities, the GWOT and related U.S. policy have created a cyclical incentive structure: certain actors within the government, military, and insurgency groups in the Philippines profit politically and financially from U.S. aid and the warlike conditions, and thus sustain, at a minimum, a presence of conflict and terrorism in order to continue drawing future benefits. This paper investigates how such actors profit from the GWOT and perpetuate conflict and examines the implications of these findings and recommendations on future U.S. policy and Philippine counter-terrorism efforts.

KEYWORDS: Philippines, Global War on Terrorism, Counter-terrorism, U.S. Policy, Military Aid, Economic Aid, Moro Islamic Liberation Front, Abu Sayyaf Group, Communist Party of the Philippines, New People’s Army

FROM APARTHEID TO DEMOCRACY: THE CIVIL-MILITARY RELATIONS IN THE REPUBLIC OF SOUTH AFRICA
Thomas H. Burchert-Commander, German Navy
Master of Arts in National Security Affairs-June 2004
Advisors: Jessica Piombo, Department National Security Affairs
Maria Rasmussen, Department of National Security Affairs

This thesis analyzes the civil-military relations in post-apartheid South Africa. The analysis is based on a theoretical framework by Moskos, et al. This framework can be used as a model to predict the development of civil-military relations in postmodern militaries of western type democracies after the end of the Cold War. In applying this model to the case of South Africa, this thesis looks at how the change in the threat perception, with the end of the Cold War and the end of apartheid, impact South Africa’s security strategy and the military’s major mission definition, the force structure, the dominant military professional, and the allocated defense budget. It also analyzes how these changes led to a change in the military’s culture, values, and norms. The role of the media, the public perception towards the military, and the role of women and homosexuals in the armed forces are used to demonstrate a change of military values and norms towards those of civilian society. Finally, the thesis takes a look at how domestic factors, such as the need for equal opportunity in order to overcome the apartheid-legacy or the high rate of HIV/AIDS, cause a change in civil-military relations. The thesis concludes that civil-military relations in South Africa are developing along the lines of the postmodern paradigm. However, South Africa has domestic issues that vary from those of consolidated democracies and influence the civil-military relations at least as much as the threat perception of the postmodern paradigm.

KEYWORDS: South Africa, SANDF, Civil-military Relations, Postmodern Military, Moskos, Post-apartheid Military, Military Transformation
NATIONAL SECURITY AFFAIRS

THE BANALITY OF ISLAMIST POLITICS
Marc D. Costain-Major, United States Marine Corps
B.A., University of California-Los Angeles, 1990
Master of Arts in National Security Affairs-June 2004
Mark A. Anderson-Lieutenant Commander, United States Navy
B.A., Johns Hopkins University, 1988
Master of Arts in National Security Affairs-June 2004
Advisor: Vali Nasr, Department of National Security Affairs
Second Reader: Peter Lavoy, Department of National Security Affairs

Political Islam has emerged as an unambiguous threat to liberal and western-leaning regimes throughout the world. Public discourse has focused on the Islamic nature of this challenge, emphasizing the cultural characteristics of the threat. In contrast, this thesis argues that Political Islam is essentially a political challenge. Further, states can and do dictate the political space available to Islamists. In order to illustrate this argument, Indonesia and Algeria serve as case studies. These two culturally, economically, and ethnically diverse nations share a predominance of Muslim adherents. Each nation has struggled with Political Islam. Yet, the consequences of state policy have profoundly differed. Recent innovations in political science theory are employed to provide a uniform structure of comparison between the two case studies. The thesis concludes that states make a choice whether to play offense or defense against their political opposition. When states choose the offensive, using targeted, preemptive repression to subsume the political space, they are successful. When states choose the defensive, using indiscriminate, reactive repression to foreclose political space, they are failures. This thesis implies that states, far from being hapless victims of fervently religious movements, can exercise a broad array of policy options to compete with Political Islam.

KEYWORDS: State, Indonesia, Algeria, Political Islam, Fundamentalism

TURKEY’S IRAN CARD: ENERGY COOPERATION IN AMERICAN AND RUSSIAN VORTEX
Erkan Dogan-First Lieutenant, Turkish Air Force
B.S., Turkish Air Force Academy, 1996
Master of Arts in National Security Affairs-June 2004
Advisor: Barak Salmoni, Department of National Security Affairs
Second Reader: James Russell, Department of National Security Affairs

This thesis analyzes the consequences of Turkey’s natural gas cooperation with Iran. These countries initiated cooperation in natural gas sales and transportation to Turkey and Europe. However, conflicting interests of many actors in energy issues make finding a solution harder. With the signing of the gas agreement between Turkey and Iran, the calculations became complicated even further. Turkey’s efforts to industrialize its economy, Iran’s struggle against U.S. sanctions along with its ideological reputation, the emergence of new independent former Soviet republics that are not very independent economically from Russia, and the U.S. objectives in enhancing the political and economic advance of those republics as well as containment of Iran are the major issues on the scene. If a compromise that would address the needs and interests of all actors in the region could be reached, the regional political and economic stability could have a substantial contribution to global security and stability. In this sense, Turkey’s natural gas cooperation with Iran plays an important role for future prospects, since it may distribute prosperity and stability through the pipelines established between two countries that can connect Central Asia to Europe.

KEYWORDS: Turkey, Iran, Energy Cooperation, Interdependence, Convergence, Interest
POLAND AND THE EUROPEAN UNION’S SECURITY AND DEFENSE POLICY

Tomasz Falecki-Lieutenant, Polish Army
B.S., Polish Military Academy of Infantry, 1998
Master of Arts in National Security Affairs-June 2004
Advisor: David Yost, Department of National Security Affairs
Second Reader: Hans-Eberhard Peters, Department of National Security Affairs

This thesis analyzes key factors in Poland’s decision making concerning the European Union’s European Security and Defense Policy (ESDP). It reviews the development of Polish policy concerning the ESDP and the main considerations that have guided Polish assessments in this regard. Poland’s position as a member of NATO and as a candidate for membership in the European Union, and other factors affecting perceptions of the ESDP in Poland, are discussed to throw light on the controversy associated with Poland’s participation in the ESDP and to clarify possible implications for the future. With Poland’s admission to the EU in May 2004, Warsaw will have an opportunity to contribute to ESDP formation and implementation. However, Poland will probably remain committed to maintaining NATO’s primacy and cautious regarding concepts of transforming the EU into an autonomous military power, especially with respect to collective defense.

KEYWORDS: European Union, European Security and Defense Policy, NATO

HOMELAND SECURITY LESSONS FOR THE UNITED STATES

Matthew A. Farr-DoD Civilian
B.S., Texas Tech University, 2001
Master of Arts in National Security Affairs-June 2004
Advisor: Lyman Miller, Department of National Security Affairs
Second Reader: Edward Olsen, Department of National Security Affairs

After the attacks of September 11, 2001, officials of the United States (U.S.) government realized that this was a new type of war that would be fought on all fronts, including inside the United States. For this reason, the Bush Administration reorganized a large part of the bureaucracy and spent billions of dollars to protect its citizens. This problem of terrorism, however, is a global problem and one that the United States shares with countries all over the world. The People’s Republic of China and Singapore are the focus of this thesis in order to determine what, if any, homeland security policies developed by their governments could be used to better protect citizens of the United States. Several policies, such as legislation, education, and internal security measures are evaluated. Each potential policy is followed by a brief description of how these laws might be instituted within the U.S. governmental system.


REALPOLITIK AND IRAN’S POST-SADDAM STRATEGY FOR IRAQ

Ryan R. Gutzwiller-Major, United States Marine Corps
B.S., California State Polytechnic University-Pomona, 1993
Master of Arts in National Security Affairs-June 2004
Advisors: Vali Nasr, Department of National Security Affairs
James Russell, Department of National Security Affairs

Throughout history, threats emerging from Iran’s frontiers have significantly influenced its security policies towards Iraq. Given Operations Iraqi Freedom and Enduring Freedom, Iran’s security environment has changed a great deal. Does Iran have a strategy for post-Saddam Iraq and, if so, what is it? With few exceptions, Kenneth Waltz’s Realpolitik and balance-of-power theories have guided Iran’s security policy decisions. The combined effects of Iran’s formative history, individual and institutional agendas, and national interests form the foundation for a Realpolitik strategy aimed at preventing a resurgent “anti-Teheran” government in Iraq. Pragmatism, consensus, influence, and competition appear to be the
watchwords for an assertive strategy built upon military prudence and cross-border, multi-disciplined engagement. Iran is putting its internal political and economic house in order so as to achieve greater effectiveness in the pursuit of its national interests vis-à-vis Iraq and the United States. While an alliance is unlikely, there is alignment with the U.S.-led coalition’s strategic interests in Iraq.


RE-INVENTING GERMAN FOREIGN AND SECURITY POLICY: A STRUGGLE TO BE UNDERSTOOD

Kevin L. Hill-Major, United States Army
B.S., North Georgia College, 1992
Master of Arts in National Security Affairs-June 2004
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Hans-Eberhard Peters, Department of National Security Affairs

This thesis uses a process-tracing methodology to analyze the development of German foreign and security policy since the end of the Cold War and German reunification. It argues that one of the key factors in the nature and development of German foreign and security policy is the distinct nature and traits of the German national security culture, also known as strategic culture. It explores the ways and areas in which German national security culture has heavily influenced the process of reform and transformation in the German armed forces since 1991. The value of this study and analysis is to be found in how a better understanding of national strategic culture can contribute to improved U.S.-German relations and toward a successful implementation of U.S. policy options toward Germany and Europe.

KEYWORDS: Foreign and Security Policy, German Strategic Culture, German Defense Reform, U.S.-German Relations

DETERRENCE AND REASSURANCE IN LITHUANIAN-RUSSIAN RELATIONS

Rolandas Kiskis-Major, Lithuanian Army
B.S., Command Military School of Engineer Forces, 1988
Master of Science in National Security Affairs-June 2004
Advisors: David Yost, Department of National Security Affairs
Anne Clunan, Department of National Security Affairs

Lithuania’s security rests at present on several pillars, including membership in NATO and the European Union and its relations with Russia. Without doubt, Lithuania’s membership in NATO and the European Union is the most promising way to preserve its independence and to promote its security. At the same time, however, Lithuania wishes to maintain constructive relations with Russia and to address Moscow’s legitimate political, military, and economic concerns. In view of the importance of domestic political factors, this thesis examines the hypothesis that Lithuania should base its security on a mix of deterrence strategies and reassurance policies pursued in cooperation with fellow members of NATO and the European Union. The thesis therefore analyzes post-Cold War trends in Lithuanian-Russian relations in light of theories of deterrence and reassurance. Three cases, NATO enlargement from 1997 to 2004, the Russian military troop withdrawal from Lithuania in 1991-1993, and Lithuanian-Russian relations concerning Kaliningrad, are discussed to assess the effects of reassurance and cooperative policies and to infer possible implications for the future.

KEYWORDS: Deterrence, Reassurance, Lithuania, Russia, Baltic States, European Security
REVOLT AGAINST THE WEST: A COMPARISON OF THE BOXER REBELLION OF 1900-1901 AND THE CURRENT WAR AGAINST TERROR

Sven Lange-Major (GS), German Army
Ph.D., Helmut-Schmidt Universität/University of the Bundeswehr Hamburg, 2003
Master of Arts in National Security Affairs-June 2004
Advisors: Lyman Miller, Department of National Security Affairs
Donald Abenheim, Department of National Security Affairs

This thesis compares the Western response to two radical challenges in eras considerably removed in time: the 1900-1901 Boxer rebellion in China and today’s Islamic terror. It brings an historical perspective to bear in assessing the strengths and weaknesses of the contemporary Western conceptualization of the al-Qaeda and Taliban threat as a “clash of civilizations.” It demonstrates that the current struggle against Islamic fundamentalism is not an altogether new challenge to Western interests and values. Al-Qaeda and the Taliban are in the end, an expression of the same forces of resistance that led to the origination of the Boxers in 19th century China. The cultural pressure that the West unavoidably developed by its imperialistic policy in the 19th and early 20th centuries was replaced, through globalization, with a worldwide penetration of the values, standards, and symbols of the Western way of life and civilization. The West might come to understand that the current terrorist threat is not “the next stage of history,” as some scholars state, but a known historical phenomenon in a new form, for which neither the West nor other cultures bear the blame.

KEYWORDS: Terrorism, “Clash of Civilizations,” Culture, al-Qaida, Taliban, Islamism, Boxer Rebellion, Globalization, Imperialism, War on Terror, United States, China, Europe, Islamic World, Afghanistan

THE NEW FIGHT ON THE PERIPHERY: PAKISTAN'S MILITARY RELATIONSHIP WITH THE UNITED STATES

Samuel L. Middleton-Major, United States Marine Corps
B.A., University of Washington, 1992
Master of Arts in National Security Affairs-June 2004
Advisor: Peter Lavoy, Department of National Security Affairs
Second Reader: Feroz Hassan Khan

This thesis explains the military relationship between the United States and Pakistan in the context of their divergent national security interests. During the Cold War, U.S. concerns focused on the global contest between democracy and communism. In this competition, Pakistan was seen as an important ally.

However, Pakistan viewed India as its primary threat and considered global ideological concerns as secondary in importance. At times, each country benefited from the other, but neither ever fully met the other’s most important needs. The United States did not support Pakistan in its wars with India and Pakistan did not confront communism except to help oust Afghani governments that were non-compliant with Pakistan’s interests. Pakistan’s military held power for more than half of Pakistan’s existence and became the U.S.’ key ally in South Asia. Pakistan’s pursuit of nuclear weapons distanced U.S. relations in the post-Cold War environment. The terrorist attacks of 11 September 2001 brought renewed emphasis to Pakistan’s importance as an ally, but at the cost of supporting a military regime and the erosion of a democratic government in Pakistan. This thesis argues that Pakistan’s military now shares a relationship with the United States that builds regional stability but which may also hold political consequences in the United States.

KEYWORDS: Pakistan, United States, National Security Strategy, Pakistani Military, South Asia, Global War on Terrorism, Musharraf, Bush, Afghanistan, Taliban
RUSSIA’S NATIONAL INTERESTS TOWARDS THE CAUCASUS: IMPLICATIONS FOR GEORGIAN SOVEREIGNTY

David Z. Papava-Civilian, Ministry of Defense, Georgia
B.A., Tbilisi State University-Georgia, 1997
Master of Arts in National Security Affairs-June 2004
Advisor: Anne Clunan, Department of National Security Affairs
Second Reader: Anna Vassilieva, Monterey Institute of International Studies

This thesis explores the causes of Russian foreign policy towards Georgia. It argues that the Russian Federation continues to pursue a policy which weakens the sovereignty of the Caucasus. The primary focus of this thesis is to identify why the Russian Federation seems to be pursuing a set of policies that economically and politically weaken the sovereignty of Georgia. Therefore, this thesis examines the forces and factors of Russian domestic politics that drive Russian national interests towards the Caucasus. The analysis focuses on one particular issue: the role of the economic elite in shaping Russia’s domestic and foreign policies vis-à-vis the state in the electricity sector. In focusing on the energy policies of the Russian Federation, this thesis reveals the negative consequences for Georgia’s sovereignty that result from a strong Russian influence in the region. This thesis analyzes how Russian national interests towards Georgia challenge the latter to establish autonomous decision making with regard to its foreign policy and to exercise its own authority through an exclusive competence in internal affairs of the state. In conclusion, this thesis offers policy prescriptions on how Georgia may best preserve its sovereignty with respect to the Russian Federation in terms of energy dependency.

KEYWORDS: Georgia, Russia, United States, Sovereignty, National Interest, Foreign Policy, Economic Security, Energy Sector, Electricity Sector, Russian Leadership, Economic Elite, RAO Unified Energy System of Russia, Gazprom

COMPARISON OF THE FRENCH AND GERMAN APPROACHES TO ESDP AND NATO

Lothar Pichler-Major, German Air Force
M.S., University of the German Armed Forces-Munich 1992
Master of Arts in National Security Affairs-June 2004
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Hans-Eberhard Peters, Department of National Security Affairs

In the process of the European implementation of a Common Foreign and Security Policy (CFSP) at Maastricht in December 1991, until the Franco-British declaration on European defense at Saint-Malo in December 1998, the European Union’s (EU) European Security and Defense Policy (ESDP) etched out the initial concept of a European Pillar within the framework of NATO, expressed in NATO’s European Security and Defense Identity (ESDI). The Franco-British declaration at Saint-Malo demonstrated the willingness of some EU member states to promote autonomous military capabilities within the EU that enables the EU to act outside of NATO’s framework. The further development of ESDP led to concern among NATO officials and U.S. diplomats regarding ESDP’s potential challenging appearance to NATO. U.S. Secretary of Defense Donald Rumsfeld expressed this concern about a growing EU opposition to the transatlantic policy of alliance. In January 2003, during the Iraq Crisis, Mr. Rumsfeld labeled France and Germany as the “Old Europe.” The relation of ESDP to NATO is strongly affected by the national interests of leading European actors like France and Germany. The development of ESDP as either a competitor or support arm of NATO depends on whether the French or the German approach to European security becomes dominant.

KEYWORDS: European Security and Defense Identity, ESDP, European Union, EU, North Atlantic Treaty Organization, NATO, France, Germany
PLANT COLUMBIA: HOW U.S. MILITARY ASSISTANCE AFFECTS REGIONAL BALANCES OF POWER

Omar Pina-Major, Venezuelan Air Force
B.S., Venezuelan Air Force Academy, 1987
Master of Science in National Security Affairs-June 2004
Advisors: Harold Trinkunas, Department of National Security Affairs
Jeff Knopf, Department of National Security Affairs

Scholars are usually attracted to South America because of the characterization of this zone of the western hemisphere as a zone with a “long peace.” However, almost 200 years after achieving independence from Spain and Portugal, some countries still face unsolved territorial and boundary disputes. Thus, the purpose of this thesis is to assess the importance of the balance of power has in the interstate relationships in the western hemisphere.

This thesis argues that Plan Colombia creates an imbalance of military power between Colombia and Venezuela and that balance is important to their relations. Three possible explanations are used to explore the relations between these two countries: democratic peace, balance of power, and spiral model. The major conclusion of this thesis is that the implementation of U.S. policy in the region is creating an imbalance of power, and that the situation could lead the unbalanced country to increase military capabilities. The long history of misperceptions of the capabilities and intentions of the adversary could provide the dynamics that trigger a war. Therefore, this U.S. policy is likely to increase tensions and instability in the dyad.

KEYWORDS: Latin America, Plan Colombia, Balance of Power, Democratic Peace, Spiral Model, Colombia, Venezuela

DEMOGRAPHIC TRENDS IN THE EUROPEAN UNION: POLITICAL AND STRATEGIC IMPLICATIONS

Clark J. Rasco-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Arts in National Security Affairs-June 2004
Advisor: David Yost, Department of National Security Affairs
Second Reader: Donald Abenheim, Department of National Security Affairs

This thesis analyzes adverse demographic trends in the European Union, including sub-replacement birthrates and increasing median ages. It investigates the implications of these trends for the EU’s prospects for becoming a stronger and more influential actor in international affairs. Pressures arising from population trends in and near the EU could ultimately affect national and EU cohesion, governmental effectiveness, and social stability.

Absent remedial measures, social programs in some EU countries will be unsustainable due to the mounting financial burden of pensions and health care for growing elderly populations. Such financial obligations hinder funding other national programs, including modernized military capabilities. Nationalism and national identity are at issue in immigrant integration and assimilation efforts. The role of population trends with regard to the growing threat of radical Islamic fundamentalism is explored.

This thesis concludes with policy recommendations to avert the looming economic, social, and security crises that may result from these demographic trends. In short, the security and financial consequences foreshadowed by the current demographic trends of an aging, economically weaker, and socially conflicted European Union present dramatic implications for the vital national interests of the United States.

HUMAN RIGHTS AND UNITED STATES MILITARY HUMANITARIAN AND CIVIC ASSISTANCE IN LATIN AMERICA

John M. Shimotsu-Lieutenant Commander, United States Naval Reserve
B.A., Virginia Military Institute, 1985
Master of Arts in National Security Affairs-June 2004
Advisors: Harold Trinkunas, Department of National Security Affairs
Karen Guttieri, Department of National Security Affairs

United States General Accounting Office evaluations of military humanitarian and civic assistance exercises from the 1980s through the mid 1990s were highly critical of their shortcomings in supporting U.S. foreign policy objectives and meeting needs of the host countries. While weaknesses in coordinating the exercises with the U.S. embassy country teams was cited as a major problem, this thesis proposes that a problem at the policy level includes the absence of planning principles congruent with a human rights agenda that includes social and economic rights. The promotion of human rights is an explicit goal of American foreign policy and this extends to defense security cooperation programs, including military humanitarian and civic assistance exercises. The thesis compares U.S. and U.N. concepts of human rights and assesses the degree to which human rights are promoted in military humanitarian and civic assistance exercises in Latin America by using case analysis. The first case involves exercise “Opening Roads,” conducted in 1987 in Ecuador, and the second involves exercise “New Horizons,” conducted in 1999 in Nicaragua. In examining the exercise objectives, the interagency process, host nation participation, and local political conditions, the cases indicate that in the post-Cold War period, humanitarian and civic assistance exercises have incorporated principles of sustainability and good governance. These principles are compatible with the expanded human rights agenda and have contributed to the effectiveness of the exercises.


Herman L. Wilkes, Jr.-Major, United States Marine Corps
B.S., Auburn University, 1987
Master of Arts in National Security Affairs-June 2004
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Hans-Eberhard Peters, Department of National Security Affairs

This thesis looks beyond the tragic events of 11 March 2004 to uncover the greater Spanish strategic culture that motivates and influences Spain’s political elites. By examining the interaction between Spanish conservatives and liberals, discerning the Spanish strategic culture allows for a greater understanding of the foreign policy implications to both the Spanish-U.S. relationship and Spanish-EU integration after the Madrid bombings. By understanding how Spanish elites make decisions on the utilization of military force with respect to NATO operations and European Union security, this thesis first demonstrates the strategic preferences of the Spanish elites. Secondly, this thesis shows that the collective identity of Spanish elites seeks further influence in regional economic and global policy making. Lastly, this thesis reveals that Spain is in a unique position to develop a strong bilateral relationship with the U.S. while furthering its integration with the EU, but is unwilling to support the furthering of cooperation and integration at the expense of Spanish national interests. Uncovering the Spanish strategic culture provides a possible generalization to whether this event will lead to a shift in the Spanish strategic culture or open a new chapter in the transatlantic relationship. This thesis suggests that the bombings will not redefine Spain’s commitment against international terrorism.

KEYWORDS: Strategic Culture, Spanish Foreign Policy, Spain, PSOE, PP, Aznar, Zapatero, NATO, European Union, Madrid Bombings, Terrorism, Global War on Terror, United States Foreign Policy, Defense Industrialization, European Security and Defense Policy, Common Foreign and Security Policy
For Turkey, Europe was the model for modernization since the era of Kemal Ataturk. Turkey’s relations with Europe started with the Ankara agreement and the opening of the custom union. Since then, the country has strived for integration with the community. The European Commission rejected Turkey’s application in 1989, while stating for the first time that political reasons over concerns about the Cyprus issue affected this decision. The integration of new members highlighted the shift of Europe towards political considerations. Turkey was rejected again as a candidate at the Luxemburg Summit. The following Helsinki Summit accepted the candidacy for Turkey, but now Turkey must comply with EU political criteria. Turkey has made great progress toward integration; however, the EU demands imply that Turkey must make strong decisions that might contradict the country’s long standing powers’ politic approach. Moreover, the EU criteria raise security concerns in a country where security is an aspect of its psychology. The implementation of such a strong decision needs a calmer democratic environment. The absence of such an environment further impedes the desired result. Thus, Turkey’s real impediment is democratic deficiency. Turkey needs a little more time to better align itself with the democratic values of the European standard. Its integration appears possible, considering the pace of reforms and the strategic weight of the country.

KEYWORDS: Turkey, Europe, Modernization, Ankara Agreement, Cyprus, Luxemburg Summit, Helsinki Summit, Candidacy, Democratic Deficiency
In March 2002, through the Homeland Security Presidential Directive Three, the Homeland Security Advisory System (HSAS) was developed. The original intent of the HSAS was to provide a warning mechanism for the federal government; other state and local agency responses were voluntary. However, the intent expanded to include a warning system for local, state, and federal agencies, the private sector and the general public.

Five orange alerts later, the confusion continues with mixed complacency. State and local officials complain about the general nature of the intelligence and the lack specificity directed at a regions or targets. The cost of orange protective measures is adding up into the billions of dollars. Warnings specific to New York City have different values in Utah.

Solutions require a new federal intelligence culture with a new name and location, under the direction of the Department of Homeland Security, distributing specific intelligence, as well as the placement of highly trained intelligence analysts working with multi-agency state or city fusion centers. The media should help in educating the public on the HSAS and promoting volunteer organizations, encouraging participation to assist in Homeland Security and to reduce the fear of a catastrophic event.

Customized HSAS should be developed for each community, state, and private sector business to better utilize protective resources. Protective measures should be implemented with specific intelligence to support the elevation of the HSAS.


Since 11 September 2001, a number of authorities have provided definitions for both Homeland Security (HS) and Homeland Defense (HD); however, as the definitions develop, they provide less functional detail. The most frequently asked question posed to professionals in the field is “What is the distinction between the Homeland Security mission and the Homeland Defense mission?” What they are really asking is, in a particular scenario, “Who’s in charge of the operation?” “When is it law enforcement, or non-military, and when is it a military operation?” Many have argued that the command structure between the two services needs to be changed to ensure the seam between HS and HD is minimized. This is a natural approach because command and control is possibly the most important of all operational functions. This thesis argues that the Navy and Coast Guard should not establish a joint interagency command structure for the missions of Homeland Security and Homeland Defense. They should continue to coordinate and support one another, when required, but they should not combine the two Services together into a permanent single organization.
METRICS FOR SUCCESS: USING METRICS IN EXERCISES TO ASSESS THE PREPAREDNESS OF THE FIRE SERVICE IN HOMELAND SECURITY
Vincent J. Doherty-Captain, Fire Department of New York City
B.S., St John's University, 1978
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Paul Stockton, Department of National Security Affairs
Second Reader: Rudolph P. Darken, Department of Computer Science

This thesis examines the current approach taken by the Fire Service to training and exercising, especially in the Fire Department of New York (FDNY), and identifies gaps and problems in those existing systems. The thesis then examines relevant “best practices” from the United States military and the private sector that might be applied to the shortfalls in Fire Service training and exercising. The remainder of the thesis proposes changes to the training and exercise system, designed to make a measurable, sustained impact on the capabilities of the fire service to accomplish Homeland Security and traditional mission requirements.

KEYWORDS: Homeland Defense, Maritime Domain, Command and Control, Interagency Task Force

THE GEORGIA INFORMATION SHARING AND ANALYSIS CENTER: A MODEL FOR STATE AND LOCAL GOVERNMENTS ROLE IN THE INTELLIGENCE COMMUNITY
Charles D. English-Director of Operations, Georgia Emergency Management Agency
B.S., Georgia State University, 1986
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Maria Rasmussen, Department of National Security Affairs
Second Reader: Robert Simeral, Department of National Security Affairs

Since 9/11 there have been many demands for robust intelligence efforts and information sharing in the context of homeland security. This thesis focuses on the critical need for the inclusion of local and state intelligence collection efforts into the broader intelligence community and describes a model for states to follow when creating a statewide Information Sharing and Analysis Center (ISAC). Key organizational and relationship principles are examined. Establishing state ISACs and including them as partners in the fight against terrorism benefits all levels of government at the strategic and tactical intelligence levels. Requirements for successful state level ISACs are identified through numerous cases studies focusing on the Georgia Information Sharing and Analysis Center.

KEYWORDS: Homeland Security, Information Sharing and Analysis Center, Georgia

STRATEGIES TO BUILD A TRUSTED AND COLLABORATIVE INFORMATION SHARING SYSTEM FOR STATE-LEVEL HOMELAND SECURITY
Robert L. Flowers-Commissioner of Public Safety, Utah
B.S., University of Utah, 1986
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Paul Stockton, Department of National Security Affairs
Second Reader: Christopher Bellavita

At all levels of government, strategies to prevent terrorism rely on the development and distribution of actionable information. It is essential that the United States strengthen its capacity to gather, share, analyze, and disseminate such information. In the State of Utah, however, these efforts have been jeopardized by a failure to adequately understand the cultural impediments to building more effective information systems. Spending more money on “stuff” (hardware, communications systems, etc.) will not provide for better information sharing, unless cultural barriers to change are recognized and taken into account in State planning.
Public safety officers in Utah are, in the author’s experience, extremely dedicated and competent public servants. Nevertheless, the top priority in Utah should be building a new culture where trust and collaboration exist among the organizations involved in homeland security. This thesis argues that such collaboration does not exist today, and will not grow naturally on its own. Further, states such as Utah need to develop and implement a strategic plan to build a culture of collaboration. This thesis proposed such a plan, tailored to overcome the specific problems that this research has uncovered.

KEYWORDS: Culture, Group Think, Trust, Parochialism

MULTI-STATE INITIATIVES – AGRICULTURE SECURITY PREPAREDNESS
Ellen M. Gordon-Civilian, Homeland Security Advisor and Emergency Management Administrator
B.S., Truman University, 1975
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Paul Stockton, Department of National Security Affairs
Second Reader: Jim A. Roth, Iowa State University

To defend American agriculture against foreign or domestic terrorism, it is essential that states build multi-state partnerships to provide for the collaborative plans, programs, and operations needed to protect the nation’s food security. The National Homeland Security Strategy puts states on the front lines in the war against terrorism, including the struggle to secure the agriculture industry from potentially devastating attack. The issues surrounding agro-terrorism are vast and complex and the resources of the Federal government to address these issues are limited and overextended. If states attempt to address this threat independently, important opportunities to reduce vulnerability and enhance capability will be lost. To achieve the capabilities needed for agro-terrorism detection, mitigation, preparedness, and response, states must collaborate to build the partnerships and programs their citizens require. This thesis argues that multi-state partnerships are critical to defeating this threat as well as providing a robust response to an attack. Whether intentionally introduced or naturally occurring, infectious diseases can easily cross state borders before an outbreak is detected. States must be prepared to act quickly to mitigate the effects of any crisis. There is a significant opportunity for states to strengthen their abilities to provide for a stronger agriculture counter-terrorism preparedness system. The states can actively further their ability to combat attacks on agriculture by demonstrating leadership in implementing administrative agreements and ultimately adopting compact(s) between states, as well as with the private sector.

PRIVATE SECURITY AS AN ESSENTIAL COMPONENT OF HOMELAND SECURITY
Christopher John Hetherington-Civilian, New York City Police Pension Fund
J.D., St. John’s University School of Law, 1987
B.A., University of Rochester, 1981
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Maria Rasmussen, Department of National Security Affairs
Second Reader: William V. Pelfrey, Department of Homeland Security

This thesis argues that first preventers are not limited to law enforcement and/or intelligence personnel. Private security officers are the true first preventers because they control access to the myriad of facilities people enter and exit every day and can recognize abnormal or unusual activity. Based on the observation by President George W. Bush in the National Strategy for Homeland Security that 85% of the nation’s critical infrastructure is owned by private agencies and organizations, one conclusion is incontrovertible: No one is in a better position to be a first preventer than the private security officer in America. In New York State, a professionally trained and licensed security officer’s primary directive is defined as detecting, deterring, and reporting on conditions which might harm life or property. It is incumbent upon government public security officials, and private security executives themselves, to cultivate and exploit this undervalued segment of the effort to combat terrorism on a national basis. In order to do so, and to assure the public of the competency of the private security workforce, it is imperative that private security officers be mandated to meet minimum standards.

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Therefore, this thesis argues that advocating nationwide, state controlled licensing and training of private security officers is essential to the efforts of the Department of Homeland Security to employ “First Responder” and “First Preventer” strategies in the war on terrorism.

**KEYWORDS:** New York State, First Preventers, Security Officer, Law Enforcement, Terrorism, Licensing, Training, Private Security Officers, First Responders

**PREEMPTION IN U.S. STRATEGIC CULTURE**
Daniela F. Marca-Ministry of Foreign Affairs, Romania  
B.S., Academy of Economic Studies-Bucharest, 2001  
Advisors: Donald Abenheim, Department of National Security Affairs  
Anne Clunan, Department of National Security Affairs

This thesis strives to shed light on the genuine significance of the current transformation of the U.S. foreign and strategic policy.

In essence, this thesis concludes that the Bush doctrine of preemption is inconsistent with the American strategic culture and view of the use of force displayed throughout the American foreign policy since the Truman Administration. Although not a revolution per se in American goals, the new foreign policy represents a radical change in the manner of pursuing those goals. While promoting a unilateralist foreign policy and revived “war-fighting” strategies, the current Administration takes old rationales a step further. By elevating preemption from the tactical to the strategic level, the doctrine transforms a last resort policy option into a primary offensive strategy with destabilizing consequences for international relations.

The analysis concludes that the increased authority of the hard-line approach in the American foreign and security policy is circumstantial, and the likelihood of its endurance is unrealistic. The international system comprises built-in constraints that raise the cost of isolationist and unilateralist impulses to unbearable levels in the long term. These constraints are the end result of the projection of American national values at an international level.

**KEYWORDS:** U.S. Foreign and Strategic Policy, War-fighting Strategies, Preemption

**EVOLUTION OF TRANSdniESTRIAN CONFLICT IN THE REPUBLIC OF MOLDOVA:**  
**PROSPECTS FOR ITS SOLUTION**  
Vitalie Nikon Marinuta-Lieutenant Colonel, Armed Forces of the Republic of Moldova  
B.S., Military Air-Borne Academy-Riazani, Russian Federation, 1992  
Master of Arts in Security Studies-June 2004  
Advisors: Jessica Plombo, Department of National Security Affairs  
Anne Clunan, Department of National Security Affairs

This thesis analyses the causes and evolution of the conflict in the Republic of Moldova and capabilities of three conflict-regulating mechanisms to facilitate the final political solution of this conflict. The leading cause of the conflict is the competition among post-Soviet politicians, fighting over the division of the Soviet state and redistribution of politico-economic benefits. In their fight for power, the elites mobilized instrumental and primordial grievances of the population, thus giving an ethnic aspect to the confrontation. As an important intervening variable for the conflict escalation into a military confrontation is Russian interest in maintaining politico-economic and military domination over the region. Over time, all ethnic causes had been eliminated, thus creating the necessary conditions for the final political settlement of the conflict. However, the status quo, created around this conflict, suits the politico-economic interests of the Transdniestrian elites, and reinforced by the Russian interest in keeping the region under its influence, is encouraging them to promote a radical position toward the process of negotiations and to demand anything but independence, a fact that cannot be accepted by the legal Moldovan Government. In such circumstances, the final solution depends on the attitudes of the external players. However, the international players are dispersed over the methods of resolving this conflict, thus reinforcing the deadlock situation in the process of negotiation. This thesis argues that under the current circumstances, none of the conflict...
regulating mechanisms, partition, confederation and federation will solve that particular conflict. However, the federalism has the most potential to serve as a tool for unification and conflict-resolution, but only if the international community and internal players will: promote democratic values, rule of law and free marked orientation in the region; reduce the benefits of the status quo situation and, finally, offer substantial politico-economic and cultural autonomy combined with fair representation at the central level to the Transdniestrian region.

KEYWORDS: Bessarabia, Moldova, Moldavia, Transdniestria, Dniester, Soviet Union, Russia, USA, Ukraine, Romania, OSCE, EU, NATO, Federalism, Partition, Secession, Confederalism, Primordialism, Instrumentalism, Ethnic Conflict, Conflict-regulation

CARROT, STICK, OR SLEDGEHAMMER: U.S. POLICY OPTIONS FOR NORTH KOREAN NUCLEAR WEAPONS
Daniel J. Orcutt-Major, United States Air Force
B.S., United States Naval Academy, 1991
M.A.S., Embry-Riddle University, 2002
Adviser: Peter Lavoy, Department of National Security Affairs
Second Reader: James J. Wirtz, Department of National Security Affairs

North Korea’s pursuit of nuclear weapons has shaken the foundations of U.S. policy in Northeast Asia. Because of North Korea’s record of state-sponsored terrorism, illicit activities, human rights violations, arms sales, and fiery rhetoric, its development of operational nuclear weapons is deeply disturbing. Although most agree that North Korea should not possess nuclear weapons, nobody has a simple solution. This thesis evaluates three U.S. policy options for the North Korean nuclear crisis: incentive-based diplomacy, coercive diplomacy, or military force. These options are analyzed according to four criteria: the impact on North Korea’s nuclear weapons, the impact on its neighbors (China, Japan, and South Korea), U.S. policy costs, and the precedent for future proliferation. This thesis shows that diplomacy will fail to achieve U.S. objectives for three reasons. First, neither the United States nor North Korea trust one another following decades of aggression and the demise of the 1994 Agreed Framework. Second, Kim Jong-il will not permit the extensive inspections that the United States demands to increase transparency. Third, multilateral coercive diplomacy is difficult, time-consuming, and not supported by Washington’s regional partners. Ultimately, Deputy Secretary of State Richard Armitage’s question must be answered: “What price is the United States willing to pay to disarm North Korean nuclear weapons?” If Washington is not willing to follow through with the threat of military force, it should not risk coercive diplomacy. Likewise, U.S. leaders may need to decide between maintaining the U.S.-ROK alliance and eliminating North Korean nuclear weapons.

KEYWORDS: Northeast Asia, North Korea, China, Japan, South Korea, United States, Nuclear Weapons, Nuclear Proliferation, Policy Options, Incentive-based Diplomacy, Coercive Diplomacy, Military Force, Kim Jong-il, Transparency, Brinkmanship, Rationality

EXPANDING THE EUROPEAN UNION’S PETERSBERG TASKS: REQUIREMENTS AND CAPABILITIES
Stavros Papastathopoulos-Major, Hellenic Army
B.A., Hellenic Military Academy, 1988
Advisor: David Yost, Department of National Security Affairs
Second Reader: Hans-Eberhard Peters, Department of National Security Affairs

This thesis analyzes the “updated Petersberg tasks” included in the draft treaty establishing a Constitution for the European Union. The original Petersberg tasks called for forces capable of humanitarian and rescue missions, peacekeeping operations, and tasks of combat forces in crisis management, including peacemaking. The updated tasks add conflict prevention, joint disarmament, military advice and assistance,
post-conflict stabilization, and support to third world countries in combating terrorism. The thesis focuses on the requirements of these tasks and the capabilities of the European Union’s civilian agencies and military forces to execute them. It explores the meaning of the new missions, their specific capability requirements, and the prospects for the European Union to meet these requirements. It concludes that the European Union is currently capable of undertaking the missions that require mostly civilian tools or medium-level military forces for their conduct. The European Union does not at present have the relevant capabilities for the missions that demand more advanced military forces.

**KEYWORDS:** European Union, EU, European Security and Defense Policy, ESDP, European Constitution, Conflict Prevention, Joint Disarmament, Military Advice and Assistance, Post-conflict Stabilization, Support in Combating Terrorism, International Cooperation, Global Peace and Security

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**FIRST RESPONDER WEAPONS OF MASS DESTRUCTION TRAINING USING MASSIVELY MULTIPLAYER ON-LINE GAMING**

Thomas J. Richardson-Captain, Seattle Fire Department
B.S., University of Washington, 1986
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisors: Ted Lewis, Department of Computer Science
Rudolph P. Darken, Department of Computer Science

In this thesis, massively multiplayer on-line gaming (MMOG) is proposed as a new methodology to provide weapons of mass destruction (WMD) response training to first responders. MMOGs training tools offer the benefits of cost savings, standardization, and increased effectiveness over traditional “in residence” training delivery methods. MMOGs can scale to meet the needs of the 4.2 million first responders in a cost efficient manner. Use of modern information technologies and MMOGs will improve overall efficiency of training delivery, while meeting the expectations and requirements of the Government Performance and Results Act as well as national strategies, to prepare an effective response to WMD terrorism.

**KEYWORDS:** Massively Multiplayer On-line Gaming, First Responder, Game Based Training, Weapons of Mass Destruction, Hazardous Materials, Information Technology, Motion Capture, Personal Protective Equipment, Incident Command System

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**SWISS ARMED FORCES XXI – THE ANSWER TO CURRENT OR FUTURE THREATS?**

Marco Schmidlin-Lieutenant Colonel, Swiss Air Force
M.A., University of Bern-Switzerland, 1996
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Richard Hoffmann, Center for Civil-Military Relations

A changed security environment after the end of the Cold War forced Switzerland, Austria, and Sweden to reassess their security policy. New threats and challenges, such as international terrorism, Weapons of Mass Destruction (WMD), organized crime, the greater disparity of wealth, and increased migration, have replaced traditional military threats. Larger non-military concerns like peacekeeping operations, humanitarian support, and support to civil authorities have replaced territorial defense, all of which require international cooperation.

Following a comprehensive security strategy, Switzerland, Austria, and Sweden aim to defend their territory, protect their population, and foster international peace and security. Austria and Sweden focus on integration and solidarity with the European Union (EU) and the North Atlantic Treaty Organization (NATO). Switzerland retains its perpetual neutrality, but has shown increased international cooperation. Austria and Sweden model their Armed Forces after the *EU Petersberg Tasks* and have small peacetime organizations with a professional cadre and annual conscripts. The Swiss Armed Forces XXI focus on territorial defense and are organized in accordance with universal conscription and wartime organization policies.
Traditional political, social, and economic aspects hinder Switzerland from following a straightforward strategy toward solidarity and fundamental change in its Armed Forces. Switzerland's new security policy and its Armed Forces XXI do not fully meet the requirements to fight new threats and challenges together with the international community.

KEYWORDS: Switzerland, Austria, Sweden, Security Policy, Security Strategy, Armed Forces, Militia Armed Forces, Neutrality, Solidarity, Military Transformation, Swiss Armed Forces XXI

FUNDING FIRST RESPONDERS FROM A THREAT AND PREVENTION APPROACH
Michael C. Weinlein-Assistant Chief, Fire Department, City of New York
B.A., Queens College, 1979
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Paul Stockton, Department of National Security Affairs
Second Reader: C.J. LaCivita, Defense Resources Management Institute

It has been thirty-three months since the United States was attacked by terrorists on September 11, 2001. Yet, in distributing grants to states and localities to build their capacity for homeland security, the Nation continues to rely on funding formulae that are deeply flawed. Many grants are distributed in ways that ignore need-driven criteria, such as where terrorists are most likely to strike and which targets are most critical. This thesis develops an alternative formula that takes need into account (and therefore is much more likely to send funds where they are required). After reviewing need-driven formulae from a range of fields that might be applied to homeland security, the Analytical Hierarchy Process (AHP) is used to break the objectives of homeland security capacity-building into discreet, measurable components. Then, the criteria that should be used to build a grant allocation process to accomplish those objectives are analyzed, including population density, criticality of infrastructure, the threat to a municipality, vulnerability to that threat, and terrorism prevention. The resulting formula is far better structured than the current system to put homeland security grant funds where they are most needed.


LEVERAGING NATIONAL GUARD COUNTERDRUG ASSETS FOR HOMELAND SECURITY
Nachelle M. Wilkinson-Major, United States Army National Guard
B.S., Florida Institute of Technology, 1988
M.P.A., University of Oklahoma, 1996
Master of Arts in Security Studies (Homeland Security and Defense)-June 2004
Advisor: Jeannie Giraldo, Department of National Security Affairs
Second Reader: John Mosbey, Department of National Security Affairs

This thesis describes how existing capabilities in the National Guard Counterdrug (NG CD) Support Program can be leveraged for use in Homeland Security (HLS) missions, and explains the implications for organizing a NG HLS Support Program. National Guard CD assets should be made dual-use for HLS activities and additional missions should be added to the CD mission, leveraging existing resources for HLS prevention. The state governors will have the flexibility of having highly trained and equipped soldiers for HLS activities according to the needs of the state and the current threat level. An already established integrated program in West Virginia provided a suitable model for conducting a case study to determine additional missions to supplement the NG CD Support Program in other states. Examples of additional CD-HLS missions include CD intelligence analysts tracking suspicious activities and CD ground reconnaissance teams cross-trained to assist with the FSIVA mission for the protection of critical infrastructure. Potential challenges of integration include funding and personnel shortages, along with legal restrictions. Solutions include developing stabilized and fenced funding with cross-leveling up to a designated threshold, adding more dual-use personnel and HLS core staffing, and amending the CD statute.

KEYWORDS: National Guard, Homeland Security, Counterdrug, West Virginia, Prevention
State governments have been recognized as the fusion point for a significant portion of policy, operational, and implementation activities for homeland security. Additionally, the most critical decisions for allocating resources and prioritizing efforts have been delegated to states. The federal government has required this role of states and has asked them to organize task forces to deal with these challenges, but has provided little guidance about how states might establish, administer, and ensure effectiveness of these structures. States have begun to establish decision making bodies independently, inconsistently, and with few measurements to evaluate effectiveness.

This thesis provides a roadmap to success for individual state organizational approaches for homeland security. The recommendations are based upon an analysis of directives, expectations, national strategies, existing approaches, and a case study of one state’s efforts. The call for organizing for the war on terror is acknowledged, accepted, and for the most part, vigorously answered. But how the nation’s states organize and to what ends their resources are applied will determine national and even international victory in the war on terrorism. This project provides a model charter, recommended outcomes and outputs for a state structure, and several policy considerations for the State of Washington’s Homeland Security infrastructure.

KEYWORDS: Homeland Security Task Force, HSTF, Organizational Structure, Model Charter, Outcomes, Outputs, Terrorism, Homeland Security
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INTRODUCTION

Mission
The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

Increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.

The research program at NPS exists to support the primary mission of graduate education. Research at NPS:
• maintains upper division course content and programs at cutting edge;
• challenges students with creative problem solving experiences on DoD relevant issues;
• advances DoN/DoD technology;
• solves warfare problems; and
• attracts and retains quality faculty.

Academic Programs
To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization tying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has aligned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer’s career.
INTRODUCTION

Programs of Graduate Studies at NPS are grouped as follows:

**Graduate School of Operational and Information Sciences**
- Computer Science
- Computers and Intelligence (C4I) Systems
- Electronic Warfare Systems International
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Operations Analysis
- Operations Logistics
- Software Engineering
- Special Operations/Low Intensity Conflict

**Graduate School of Engineering and Applied Sciences**
- Combat Systems Science and Technology
- Electrical Engineering
- Electronic Systems Engineering
- Engineering Acoustics
- Meteorology
- Meteorology and Oceanography
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors/Mechanical Engineering

**Graduate School of Business and Public Policy**
- Acquisition and Contract Management
- Contract Management
- Defense Systems Analysis
- Defense Systems Management (International)
- Financial Management
- Information Systems Management
- Leadership Education and Development
- Manpower Systems Analysis
- Material Logistics Support Management
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Transportation Management

**School of International Graduate Studies**
- Civil-Military Relations
- Defense Decision Making and Planning
- Homeland Security Leadership Development
- National Security and Intelligence
- Europe/Russia/Central Asia
- Far East/South-East Asia/Pacific
- Middle East/Africa/South Asia
- Western Hemisphere

**Interdisciplinary Curricula**
- Modeling, Virtual Environments and Simulation
- Product Development
- Space Systems Engineering
- Space Systems Operations
- Space Systems Operations International
- Systems Engineering and Analysis
- Systems Engineering Management
- Undersea Warfare

**Students**
The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government and military officers and government civilian employees of other countries. Resident degree/subspecialty student population for September 2004 is shown in Figure 1 on the following page.
**INTRODUCTION**

![Pie chart showing the distribution of degrees and specialties.]

*Figure 1: Resident Degrees/Subspecialty Student Population for September 2004 (Total Enrollment: 1,581)*

* U.S. Coast Guard, U.S. Army National Guard, U.S. Army Reserve, National Oceanographic Atmospheric Administration

### Academic Degrees

Although the curricula are tailored to address defense requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a master’s degree; however, additional study can lead to either an engineer’s degree or the doctor’s degree. Below is a listing of the degrees offered at NPS:

#### Master of Arts Degrees
- National Security Affairs
- Security Studies

#### Master of Business Administration
- Executive MBA
- Master of Business Administration

#### Master of Science Degrees
- Applied Mathematics
- Applied Physics
- Applied Science
- Astronautical Engineering
- Combat Systems Technology
- Computer Science
- Contract Management
- Defense Analysis
- Electrical Engineering
- Engineering Acoustics
- Engineering Science
- Information Systems and Operations
- Information Technology Management
- Leadership and Human Resource Development
- Management
- Materials Science and Engineering
- Mechanical Engineering
- Meteorology
- Meteorology and Physical Oceanography
- Modeling, Virtual Environments and Simulation
- Operations Research
- Physical Oceanography
- Physics
- Product Development
- Program Management

#### Engineer Degrees
- Astronautical Engineer
- Electrical Engineer
- Mechanical Engineer

#### Doctor of Philosophy
- Applied Mathematics
- Applied Physics
- Astronautical Engineering
- Computer Science
- Electrical Engineering
- Engineering Acoustics
- Information Science
- Mechanical Engineering
- Meteorology
- Modeling, Virtual Environments and Simulation
- Operations Research
- Physical Oceanography
- Physics
- Software Engineering

#### Doctor of Engineering
- Astronautical Engineering
- Engineering Acoustics
- Mechanical Engineering
INTRODUCTION

There were 217 degrees conferred in September 2004. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.

![Figure 2. Distribution by Degree Type (217 Degrees Conferred)](image)

![Figure 3. Degrees Conferred in September 2004 (217 Degrees Conferred)](image)

* Ph.D. Mechanical Engineering (1); Ph.D. Operations Research (1); Ph.D. Software Engineering (1); Astronautical Engineer (1); M.S. Astronautical Engineering (1); M.S. Applied Mathematics (1); M.S. Applied Science (1); M.S. Contract Management (2); M.S. Engineering Acoustics (1); M.S. Leadership and Human Resource Development (2); M.S. Physics (1); M.S. Program Management (3); M.S. Software Engineering (2); M.S. Systems Engineering Management (1); M.S. Systems Technology (1).
INTRODUCTION

Thesis
The thesis is the capstone achievement of the student’s academic endeavor at NPS. Thesis topics address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Students, with their faculty advisors, provide a very unique capability within the DoD for addressing warfighting problems. This capability is especially important at the present time when technology in general, and information operations in particular, are changing rapidly. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are rapidly being developed in both the commercial and military sectors. Their unique knowledge of operations, when combined with a challenging thesis project which requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet/Joint Force problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.

Figure 4. Classification of Theses
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ADVANCED DEGREES

Doctor of Philosophy
Astronautical Engineer
DOCTOR
OF
PHILOSOPHY

AUTONOMOUS OPTIMAL RENDEZVOUS OF UNDERWATER VEHICLES
John W. Nicholson-Captain, United States Navy
B.S., United States Naval Academy, 1981
O.E., Woods Hole Oceanographic Institute, 1988
Doctor of Philosophy in Mechanical Engineering—September 2004
Advisor: Anthony J. Healey, Department of Mechanical and Astronautical Engineering

The capability of an autonomous underwater vehicle (AUV) to rendezvous with other AUVs was implemented and demonstrated in the Naval Postgraduate School ARIES AUV, providing a method of overcoming the severe range limitations of high-bandwidth underwater data transfer methods in order to enable accelerated access to data collected by a network of data-gathering survey AUVs. Rendezvous was implemented by autonomous reconfiguration of ARIES’ operations, using a mission planning module to combine acoustically-transmitted rendezvous requests from survey AUVs with pre-stored survey AUV mission data to generate rendezvous missions based either on time-optimal or energy-optimal trajectories. The planning module efficiently generates rendezvous trajectories based on solutions derived using optimal control theory. A new third layer of control, based on a finite state machine, was added above ARIES’ autopilot and mission execution functions in order to initiate mission planning and replanning, activate missions, sequence vehicle operations through seven defined states, control acoustic communications, and handle perturbations and missed rendezvous.

KEYWORDS: AUV, UUV, Robotics, Rendezvous, Cooperative Behavior, Trajectory Planning, Path Planning, Acoustic Communications, State Machine, Optimal Control

IMPROVING BRANCH-AND-PRICE ALGORITHMS AND APPLYING THEM TO STOCHASTIC PROGRAMS SYSTEMS
Eduardo Ferreira Silva-Lieutenant Commander, Brazilian Navy
B.S., Brazilian Naval Academy, 1986
M.S., Fluminense Federal University—Brazil, 1998
M.S., Fluminense Federal University—Brazil, 2000
Doctor of Philosophy in Operations Research—September 2004
Advisor: R. Kevin Wood, Department of Operations Research

The first phase of this research demonstrates improvements in the performance of branch-and-price algorithms (B&P) for solving integer programs by: 1) stabilizing dual variables during column generation, 2) performing strong branching, 3) inserting multiple near-optimal columns from each subproblem, 4) heuristically improving feasible integer solutions, and applying several other techniques. Computational testing on generalized-assignment problems shows that solution times decrease over “naïve” B&P by as much as 96% and some problems that could not be solved by standard branch and bound on the standard model formulation have become easy to solve.

In the second phase, this research shows how to solve a class of difficult, stochastic mixed-integer programs using B&P. A new, column-oriented formulation of a stochastic facility-location problem (SFLP), using a scenario representation of uncertainty, provides a vehicle for demonstrating the viability of this method. Computational results show that B&P can be orders of magnitude faster than solving the original problem by branch and bound, and this can be true even for single-scenario problems; i.e., for deterministic problems. B&P also solves SFLP exactly when random parameters are modeled through certain continuous probability distributions. In practice, these problems solve more quickly than comparable scenario-based problems, with for example, 50 scenarios.
A FORMAL APPLICATION OF SAFETY AND RISK ASSESSMENT IN SOFTWARE SYSTEMS

Christopher Loyal Williamson-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1991
M.S., Naval Postgraduate School, 2000
Doctor of Philosophy in Software Engineering-September 2004
Advisor: Luqi, Department of Computer Science
Second Reader: Mikhail Auguston, Department of Computer Science

The current state of the art techniques of Software Engineering lack a formal method and metric for measuring the safety index of a software system. The lack of such a methodology has resulted in a series of highly publicized and costly catastrophic failures of high-assurance software systems. This dissertation introduces a formal method for identifying and evaluating the weaknesses in a software system using a more precise metric, counter to traditional methods of development that have proven unreliable. This metric utilizes both a qualitative and quantitative approach, employing principles of statistics and probability to determine the level of safety, likelihood of hazardous events, and the economic cost-benefit of correcting the flaws through the lifecycle of a software system. This dissertation establishes benefits in the fields of software engineering of high-assurance systems, improvements in software safety and software reliability, and an expansion within the discipline of software economics and management.

This thesis considers the problem of generating optimal entry trajectories for a reusable launch vehicle following control surface failures. The thesis builds upon the work of Dr. David Doman, Dr. Michael Oppenheimer, and Dr. Michael Bolender of the Air Vehicles Directorate, Air Force Research Lab (AFRL), Dayton, Ohio. The primary focus of this work is to demonstrate the feasibility of inner loop reconfiguration and outer loop trajectory retargeting and replanning for the X-33 reusable launch vehicle (RLV) following the imposition of a control surface failure. The trajectory generation model employs path constraints generated by an AFRL trim deficiency algorithm, coupled with an inner loop control allocator and aerodynamic database that captures the full 6-DOF vehicle aerodynamic effects while utilizing an outer loop 3-DOF model. The resulting optimal trajectory does not violate the trim deficiency constraints and provides additional margins for trajectories flown during failure conditions. The footprints generated by the thesis show that contemporary footprint analysis for vehicles experiencing control surface failures are overly optimistic when compared to those footprints that consider vehicle aerodynamic stability and realistic landable attitudes at the threshold of the landing runway. The results of this thesis also show the performance reductions resulting from decoupling the inner and outer loop and that trajectories can be generated to the landing runway without using a region of terminal area energy management.

**KEYWORDS:** Reentry, X-33, Reusable Launch Vehicle, Pseudospectral, Trajectory, Reconfiguration, Replanning, Retargeting, Control Surface Failures
MASTER
OF
BUSINESS ADMINISTRATION
ADDING A PRESCRIPTION DRUG BENEFIT TO MEDICARE: AN ANALYSIS OF THE
MEDICARE PRESCRIPTION DRUG, IMPROVEMENT, AND MODERNIZATION ACT OF 2003

Carla D. Jones-Lieutenant, United States Navy
Master of Business Administration-September 2004
Advisor: Richard B. Doyle, Graduate School of Business and Public Policy
Second Reader: Frank J. Barrett, Graduate School of Business and Public Policy

The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 added an outpatient prescription drug benefit to Medicare. This benefit was a recurring topic among lawmakers who have attempted to add an outpatient prescription drug benefit many times since Medicare was enacted in 1965. The 2003 legislation marked the most significant and expensive overhaul of Medicare since its inception. This legislation was enacted during a time of record federal budget deficits and Republican control of Congress and the White House. The major compromise that allowed this legislation to succeed concerned the total funding available, the amount of privatization in the design and administration of the benefit, and the scope of the coverage. This thesis identifies and describes the primary stakeholders involved and their influences on the benefit, including political parties, Congress, the Bush Administration and interest groups, and summarizes previous attempts at similar legislation. Sources include Congressional testimony, government cost estimates, legislation, journal articles, and reports or research from think-tanks. The thesis analyzes the legislative process that produced Medicare reform and identifies problems and issues resulting from the reform.

KEYWORDS: Medicare, Prescription Drug, Medicare Part D, Medicare Reform, Medicare Prescription Drug, Improvement, and Modernization Act of 2003

USING COMMERCIAL AVIATION INFORMATION SYSTEMS IN OPERATIONAL SUPPORT
AIRLIFT DECISION SUPPORT SYSTEMS

Charles P. Kubik, II-First Lieutenant, United States Air Force
Master of Science in Information Technology Management-September 2004
Master of Business Administration-September 2004
Advisors: Roxanne Zolin, Graduate School of Business and Public Policy
Glenn Cook, Department of Information Sciences

Air travel within the Department of Defense (DoD) could potentially be reinvented due to the disruptive technology of microjets. These smaller, more efficient aircraft will be able to provide cost effective point to point travel to their users. Along with this new way of travel comes the challenge of managing the customer requests, large networks of jets, personnel, and support activities. Decision Support Systems (DSS) can help manage these networks by attempting to create optimized scheduling solutions for the routing aircraft, crews, and logistical support needed to successfully operate in this new environment. The opportunity exists for the DoD’s private aircraft operation, the Joint Operational Support Airlift Center (JOSAC), to utilize some of the same system features used in commercial operations, such as NetJets, to improve operations.

This thesis will analyze the use of commercial air operator strategies and DSSs in JOSAC to improve operational effectiveness. It will look to add new capabilities and processes used in commercial DSSs, along with the implementation of the disruptive technology, microjets. Some of the potential benefits include improved operational performance, solutions to scheduling inefficiencies and improved mission readiness. With these improvements, the potential for a military microjet operation in the future is a real possibility.
The purpose of this MBA project is to identify and analyze the federal government information technology services market to be used in OpalSoft’s operational application. A general review of OpalSoft’s current operations and strategy was conducted. The core of the project concentrates on the review and analysis of the federal government information technology services sector. This portion of the project will present regulatory mandates, data reviews, and survey findings from various federal contracting organizations. These analytical insights should facilitate OpalSoft in achieving its future goals and objectives in this market. The end-state of this project is to supply OpalSoft with a greater understanding of the federal government market and to capitalize on opportunities presented by that market.

**KEYWORDS:** OpalSoft, Federal Government Information Technology Services Market

This thesis analyzes the role of the Navy’s Lateral Transfer and Redesignation (LT&R) process in supporting officer flows across communities. Both surpluses and shortages of officers significantly impact the productivity and readiness of the Navy. Currently several methods exist to redistribute excess officer inventories in some communities to fill officer shortages in other communities. Current policies often adversely affect retention and may prevent the internal officer labor market from efficiently redistributing officers. The LT&R process is the primary process used by several Officer Community Managers to access officers at the junior and mid-grade levels. However, the Navy restricts the ability of officers to redesignate or transfer. Significant officer supply comes predominately from grades 0-2 and 0-3 in the Surface Warfare community. The demand comes from officer shortages, mostly in the Restricted Line and Staff Communities.

The data analyzed for this research represent officer cohorts 1987 through 2003. The data show that sufficient officer inventories exist to meet requirements, but more flexible LT&R policies are required to ensure the inventory (supply) is efficiently distributed among communities with shortages. The data also show that officers who transfer after O-3 tend to stay to 0-4, whereas officers who transfer before O-3 tend to leave the service. The LT&R process should be seen as a force-shaping tool to redistribute qualified officers at the junior and mid-grade levels; it improves retention by allowing officers to transfer across communities and also improves Navy force efficiencies by increasing return on training investments (ROI) by retaining proven performers. Additionally, officers who are allowed to transfer tend to have greater job satisfaction, which tends to improve retention.

**KEYWORDS:** Lateral Transfer, Redesignation, Force-shaping, Officer Program Authorization, Designators, End Strength, Training Attrition, Officer Groups, Officer Community Manager
This project is a comparative analysis of the implementation process of Activity Based Cost Management (ABCM) of Marine Corps Logistics Base (MCLB), Albany, New York, and the implementation procedures used aboard MCB Camp Lejeune, NC. Interviews were conducted and data was gathered to identify how the respective Business Performance Offices (BPO) plan, implement, monitor, and measure performance of their process to introduce ABCM at the base installation level. The means of allocating the two organization’s resources to this change process and their cost objects were studied. An analysis of benchmarking goals and relative barriers to the implementation was conducted to find commonalities between the two, or to determine if they are unique to each organization. This project is not intended to identify which, if either, process is superior or if inherent problems or impediments are attributable to any internal issues within the respective organizations. The project describes and discusses environmental differences that facilitate or hinder the implementation and offers recommendations to aid in ABCM implementation process procedures.

**KEYWORDS:** Marine Corps, Activity Based Cost Management, ABCM, Business Performance Office, BPO, Benchmark, Implementation
MASTER OF SCIENCE

Applied Mathematics
Applied Science
Astronautical Engineering
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Information Systems and Operations
Information Technology Management
Leadership and Human Resource Development
Mechanical Engineering
Meteorology and Physical Oceanography
Modeling, Virtual Environments and Simulation
Operations Research
Physics
Program Management
Software Engineering
Space Systems Operations
Systems Engineering
Systems Engineering Management
One of the major problems with a Limited Area Model (LAM) is the introduction of error from the lateral boundaries. The boundary condition provides a source of forcing to the interior of the model. This forcing typically originates from a global model such as the Navy Operational Global Atmospheric Prediction System (NOGAPS). The transition at the boundary from one model to another invariably produces errors. Traditionally, the way to minimize boundary error is to move the boundary as far away from the area of interest as possible. In this way, the errors do not have time to infest the LAM with “bad” information. Moving the boundary far away from the area of interest increases the computational forecast load and decreases its timeliness. This study looks at how close the lateral boundary can be to minimize computational time and still maintain a forecast that is useful. It was found that when the entire inner Coupled Ocean Atmosphere Prediction System (COAMPS) nest was analyzed, the differences between the control forecast and the test forecast were within the natural variability of the control grid. It was also found that there were localized areas within the model domain that differed between the control domain and the test domain by up to 20 mb for the sea level pressure after a six day forecast.

**KEYWORDS:** Local Area Model, Lateral Boundary Conditions, COAMPS
MASTER OF SCIENCE
IN
APPLIED SCIENCE

THE CIRCULATION AND FLUXES FROM THE ARCTIC INTO THE NORTH ATLANTIC OCEAN: 1979-2002 MODEL RESULTS
Catherine E. Williams-Ensign, United States Navy
B.S., United States Naval Academy, 2003
Master of Science in Applied Science (Physical Oceanography)-September 2004
Advisor: Wieslaw Maslowski, Department of Oceanography
Second Reader: Albert Semtner, Department of Oceanography

The recent decreasing trend of sea ice cover in the Arctic region and its projected future reduction has direct implications for the global thermohaline circulation and the U.S. Navy. This thesis provides a qualitative and quantitative analysis of the freshwater export from the Arctic Ocean through the Canadian Arctic Archipelago (CAA) and the Fram Strait into the deep-water formation region of the Labrador Sea, using model data from 1979 to 2002. The results of this thesis directly aid the Navy in preparing personnel, ships, and weapons systems to operate efficiently in a possibly ice-free Arctic.

A coupled ice-ocean model of the pan-Arctic region at a 1/12-degree and 45-level grid resolution was used to produce data over a 24-year time period. Annual velocity, temperature, and salinity profiles averaged over a 24-year period were compared for each of the analyzed stations. Additionally, 24-year mean monthly volume and freshwater flux time series plots and annual cycle plots were also produced to analyze the region’s interannual variability from 1979 to 2002.

The results show that the Canadian Arctic Archipelago is the major contributor of freshwater to the Labrador Sea. The CAA is a direct pathway for increased freshwater export from the Arctic into the subarctic seas where North Atlantic Deep Water (NADW) forms. The increased freshwater flux through the CAA found in this study supports the earlier reports on the freshening of NADW and the possibility of reduction in the meridional overturning rate in the North Atlantic. An increase in freshwater export from the Arctic is a good indicator of increasing sea ice reduction. The predicted opening of the Arctic to commercial and military vessels poses a direct threat to U.S. economical and strategic interests in the Arctic region. This thesis supports the U.S. Navy’s ability to operate in a possibly ice-free Arctic.

KEYWORDS: Canadian Arctic Archipelago, CAA, Arctic Ocean, Ocean Modeling
This thesis considers the problem of generating optimal entry trajectories for a reusable launch vehicle following control surface failures. The thesis builds upon the work of Dr. David Doman, Dr. Michael Oppenheimer, and Dr. Michael Bolender of the Air Vehicles Directorate, Air Force Research Lab (AFRL), Dayton, Ohio. The primary focus of this work is to demonstrate the feasibility of inner loop reconfiguration and outer loop trajectory retargeting and replanning for the X-33 reusable launch vehicle (RLV) following the imposition of a control surface failure. The trajectory generation model employs path constraints generated by an AFRL trim deficiency algorithm, coupled with an inner loop control allocator and aerodynamic database that captures the full 6-DOF vehicle aerodynamic effects while utilizing an outer loop 3-DOF model. The resulting optimal trajectory does not violate the trim deficiency constraints and provides additional margins for trajectories flown during failure conditions. The footprints generated by the thesis show that contemporary footprint analysis for vehicles experiencing control surface failures are overly optimistic when compared to those footprints that consider vehicle aerodynamic stability and realistic landable attitudes at the threshold of the landing runway. The results of this thesis also show the performance reductions resulting from decoupling the inner and outer loop and that trajectories can be generated to the landing runway without using a region of terminal area energy management.

KEYWORDS: Reentry, X-33, Reusable Launch Vehicle, Pseudospectral, Trajectory, Reconfiguration, Replanning, Retargeting, Control Surface Failures
DEVELOPING A RELIABLE METHODOLOGY FOR ASSESSING THE COMPUTER NETWORK OPERATIONS (CNO) THREAT OF NORTH KOREA

Christopher A. Brown-Lieutenant, United States Navy
B.S., College of Aeronautics, 1993
Master of Science in Computer Science-September 2004
Advisor: Dorothy Denning, Department of Defense Analysis
Second Reader: Joanne Kim, National Security Agency Chair Professor

Computer network operations (CNO) can be considered a relatively new phenomenon being encountered in modern warfare. Computer network operation is comprised of three components: computer network attack, computer network exploitation (CNE) and computer network defense (CND). Computer network attack is defined as operations to disrupt, deny, degrade or destroy information resident in computer networks, or the computers and networks themselves. Computer network exploitation is the intelligence collection and enabling operations to gather data from target adversary automated information systems (AIS) or networks. Finally, computer network defense are those measures, internal to the protected entity, taken to protect and defend information, computers, and networks from disruption, degradation or destruction.

No longer is warfare limited to the use of kinetic weapons and conventional methods of war. Computer network operations have become an integral part of our adversary's arsenal and more attention must be paid to the effects of CNO activities, particularly CNA and CNE being conducted by our adversaries. Of the many states suspected of conducting active CNO activities against the United States and other nations, none warrants more attention than North Korea.

This thesis presents the development of methodology using information available from open sources. This work is intended to prove that a useful methodology for assessing the CNO capabilities and limitations of North Korea can be developed using only open source information.


HIGH SPEED INTERNET ACCESS USING CELLULAR INFRASTRUCTURE

Ioannis Chatziioannidis-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1993
Master of Science in Computer Science-September 2004
Advisor: Bert Lundy, Department of Computer Science
Second Reader: John Gibson, Department of Computer Science

The way that the Internet is accessed has changed dramatically in recent years. In addition to wire line connections such as dial-up, xDSL, cable modems, or optical fiber, wireless implementations are gaining market share based on technologies such as WiFi, WiMAX, MBWA, satellite, and cell phone networks.

This thesis examines the potential usage of providing Internet access through cellular infrastructure. The cellular evolution path from first generation (1G) to third generation (3G) and fourth generation (4G) systems is studied and presented. The most popular worldwide cellular voice and data network technologies are also described. Additionally, the Cingular Wireless network in Monterey, California, is tested in terms of speed and reliability by providing Internet access to a laptop through a mobile phone. The analysis shows that, depending on the cellular network availability, throughput varied from 5 to 25 Kbps and Round Trip Time (RTT) averaged about one second. Furthermore, it is shown that TCP Timestamps and the Explicit Congestion Notification (ECN) were implemented at the end hosts, thus increasing performance.

The thesis concludes that as of July 2004, the 2.5G cellular data networks are a reasonable solution for those who need Internet access anywhere that a cell signal is available (including from moving vehicles).
and who can afford its high cost. For others, it is not yet an acceptable solution. However, the future 3G networks are an excellent solution in wireless broadband Internet access. These will probably be relatively expensive at first, but the cost should eventually decrease to a reasonable level.

**KEYWORDS:** Internet, Wire Line Connections, Dial-Up, xDSL, Cable Modems, Optical Fiber, Wireless, WiFi, WiMAX, MBWA, Satellite, Cell Phone, Networks, First Generation, 1G, Third Generation, 3G, Fourth Generation, 4G, Round Trip Time, RTT, TCP, Explicit Congestion Notification, ECN

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**A FORMAL ANALYSIS OF THE MLS LAN: TCB-TO-TCBE, SESSION STATUS, AND TCBE-TO-SESSION SERVER PROTOCOLS**

Daniel S. Craven-Federal Deposit Insurance Corporation Civilian  
B.A., University of California at Santa Barbara, 1994  
Master of Science in Computer Science-September 2004  
Advisor: George W. Dinolt, Department of Computer Science  
Second Reader: Sylvan S. Pinsky, National Security Agency

This thesis presents a formal analysis process and the results of applying that process to the Multilevel Secure Local Area Network (MLS LAN): TCB-to-TCBE, Session Status, and TCBE-to-Session Server Protocols. The formal analysis process consists of several distinct stages: the creation of a detailed informal protocol description, analyzing that description to reveal assumptions and areas of interest not directly addressed in the protocol description, the transformation of that description and the related assumptions into a formal Strand Space representation, analyzing that representation to reveal assumptions and areas of interest, and concluding with the application of John Millen’s automated Constraint Checker analysis tool to the Strand Space representations under an extremely limited set of conditions to prove certain protocol secrecy properties.

**KEYWORDS:** Protocol Analysis, Constraint Checker, Strand Spaces

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**ESTABLISHING LINUX CLUSTERS FOR HIGH-PERFORMANCE COMPUTING (HPC) AT THE NAVAL POSTGRADUATE SCHOOL**

Christos Daillidis-Major, Hellenic Army  
B.S., Hellenic Military Academy, 1989  
Master of Science in Computer Science-September 2004  
Advisors: Donald P. Brutzman, Department of Information Sciences  
Don McGregor, Department of Computer Science

Modeling and simulation (M&S) needs high-performance computing resources, but conventional supercomputers are both expensive and not necessarily well suited to M&S tasks. Discrete Event Simulation (DES) often involves repeated, independent runs of the same models with different input parameters. A system that is able to run many replications quickly is more useful than one in which a single monolithic application runs quickly. A loosely coupled parallel system is indicated.

Inexpensive commodity hardware, high speed local area networking, and open source software offer the potential to create just such loosely coupled parallel systems. These systems are constructed from Linux-based computers and are called Beowulf clusters.

This thesis presents an analysis of clusters in high-performance computing and establishes a testbed implementation at the Modeling, Virtual Environments and Simulation Institute at NPS. It describes the steps necessary to create a cluster, factors to consider in selecting hardware and software, and the process of creating applications that can run on the cluster. Monitoring the running cluster and system administration are also addressed.

**KEYWORDS:** Clusters, Beowulf, HPC, Rocks, HPL, BPS
As the number of computer users has increased within the last several years, so has the number of attacks on assets stored on computer devices. Despite an increase in computer security awareness, many users and policy makers still do not implement security principles in their daily life. Ineffective education and the lack of personal experience with and understanding of computer security might be the main causes. The CyberCIEGE game can be used to convey requisite facts and to generate tacit understanding of general computer security concepts to a broad audience.

This thesis researched whether a Scenario Definition File (SDF) for the CyberCIEGE game could be developed to educate and train players in Information Assurance on matters related to a networking environment with respect to integrity. The primary educational concern is the protection of stored data. Another goal was to test whether the game engine properly simulates real world behavior.

The research concluded that it is possible to create SDFs for the CyberCIEGE game engine that can teach specifically about integrity issues. Three specific SDFs were developed for teaching purposes. Several SDFs were developed for demonstrating the game engine’s ability to simulate real world behavior for specific, isolated educational goals. These tests led to recommendations to improve the game engine.

**KEYWORDS:** Computer Security, Integrity, Software Integrity, Trap Door, Social Engineering, MAC Enforcement Mechanism, Educational Goals, Information Assurance, CyberCIEGE, Scenario Definition File

The unfortunate events of September 11, 2001, have renewed efforts to protect the nation’s critical infrastructures. Many of the sectors that make up the critical infrastructure rely upon Supervisory Control and Data Acquisition (SCADA) systems. The importance of the SCADA systems was reinforced during the massive power outage that occurred in August 2003.

This thesis consolidates some of the research that has already been done in the area of SCADA vulnerability assessment and applies it by developing an initial vulnerability assessment checklist for Department of the Navy systems. This checklist can and should also be used in the certification and accreditation of DoN SCADA systems.

In addition, a promising technology was discovered during this research that should be explored further to secure SCADA communications. This new discovery is touched on briefly.

**KEYWORDS:** Vulnerability Assessment, SCADA, Supervisory Control and Data Acquisition, Information Assurance
A TRUSTED PATH DESIGN AND IMPLEMENTATION FOR SECURITY ENHANCED LINUX

Allan T. Hilchie-DoD Civilian
B.S., Northern Arizona University, 2000
Master of Science in Computer Science-September 2004
Advisors: Cynthia E. Irvine, Department of Computer Science
David Shifflett, Department of Computer Science

The threat posed to computers by malicious software and networked adversaries has resulted in the development of mechanisms to provide assurance that security sensitive information is not being compromised. One such mechanism is called a Trusted Path. A Trusted Path provides a protected communications channel that permits the computer to authenticate itself to the user and for the user to authenticate to the system.

This thesis provides a demonstration implementation of a Trusted Path for Security Enhanced Linux (SELinux) and is used to examine Trusted Paths, their design, and implementation. Additionally, the effectiveness of a Trusted Path for SELinux is analyzed.

This research is meant to provide a framework that could be used in combination with other efforts to enhance the security of SELinux.

KEYWORDS: Linux, Security Enhanced Linux, Trusted Path, Secure Attention Key, Computer Security

DEVELOP, BUILD, AND TEST A VIRTUAL LAB TO SUPPORT VULNERABILITY TRAINING SYSTEM

Coskun Kargin-First Lieutenant, Turkish Army
B.S., Turkish War College, 1998
Master of Science in Information Technology Management-September 2004
Turgut Akgul-First Lieutenant, Turkish Army
B.S., Turkish War College, 1999
Master of Science in Computer Science-September 2004
Advisor: Richard M. Harkins, Department of Physics
Second Reader: Wen Su, Department of Computer Science

A computer security virtual lab architecture is developed and tested for functionality and performance. Four Dell PowerEdge 1650, dual processor, blade servers are configured as host machines with VMware and VNC running on a Linux RedHat 9 Kernel. An Apache-Tomcat web server is configured as the external interface to lab users. Web content is created, the site is secured with Secure Socket Layers, and Java Servlet functionality is enabled. Host machine performance is tested under various load conditions.

Analysis indicates that for this architecture, the average host machine CPU load was ~12 %, while the average memory load was ~33 %. It was concluded that for the cost and space requirements of 51U blade servers, an equivalent 20 computer lab was configured. Performance tests show that the virtual lab could scale easily from four to thirty computers.

KEYWORDS: Virtual Lab, Virtual Network, Virtual Machine, Web Server, Apache, Tomcat, VMware, VNC, SSL

EXPLORING THE FEASIBILITY OF THE VIRTUAL ENVIRONMENT HELICOPTER SYSTEM (VEHELO) FOR USE AS AN INSTRUCTIONAL TOOL FOR MILITARY HELICOPTER PILOTS

Walter W. Kulakowski-Major, United States Marine Corps
B.S., University of Florida, 1992
Master of Science in Computer Science-September 2004
Advisor: Rudolph P. Darken, Department of Computer Science
Second Reader: CDR Joseph A. Sullivan, USN, Department of Computer Science

The requirement for low-level navigation flight is something unique to the military helicopter pilot. Novice helicopter pilots are introduced to this skill via a limited number of flights/flight hours. A low situational
Computer Science

Awareness (SA) is historically noted among the first flights of novice pilots within this flight regime. To that end, this thesis continues with the development of the ChrAVE implementation of the Virtual Environment Helicopter System (VEHELO) that places the pilot in an immersive and familiar cockpit using chromakeyed technology. In the VEHELO, the pilot is able to learn and exercise required piloting tasks and multi-place aircraft communications as authentically and as meticulously as in actual flight.

The focus of this thesis is to continue system validation and its use as an instructional tool. This will be accomplished by comparing data collected by pilots flying the ChrAVE and data collected by pilots flying the actual aircraft during initial navigational training flights. Additionally, this thesis will attempt to show that the latest version of the system has a previously unrecognized ability to improve pilot performance. The system is capable of teaching novice pilots the important skill of Crew Resource Management (CRM) and the appropriate communication skills. The system is comprised of commercial-off-the-shelf (COTS) equipment mounted in a mobile box.

Keywords: Chromakey, Chrommat, Fleet Replacement Squadron, FRS, Helicopter, Human-computer Interface, Mission Rehearsal, Navigation, Route Rehearsal, Spatial Orientation, Litering, Refresher Aircrew Training, RAC, Terrain Association, Virtual Environments, VEHELO, LED Light Ring

A CyberCIEGE Scenario Illustrating Secrecy Issues in an Internal Corporate Network Connected to the Internet

Justin Lamorie-Captain, United States Marine Corps
B.S., Arizona State University, 1993
Master of Science in Computer Science-September 2004
Advisors: Cynthia E. Irvine, Department of Computer Science
Paul C. Clark, Department of Computer Science
Second Reader: Michael F. Thompson, Aesec Corporation

The CyberCIEGE project seeks to create an alternative to traditional Information Assurance (IA) training and education approaches by developing an interactive, entertaining, commercial-grade PC-based computer game that teaches IA concepts while simultaneously entertaining the player. The game provides a robust, flexible, and extensible gaming environment where each game instance is based on a fully customizable scenario.

These customized scenarios produce game simulations that are tailored to meet a player’s specific IA training needs and thus provide personalized, focused IA training at a minimum cost in both dollars and time. Additionally, the interactive game simulations provided by the CyberCIEGE game create an entertaining and realistic training environment for the player. Finally, the ability to load the game onto and execute from a PC provides the trainer with the ability to conduct IA training from virtually anywhere, i.e. at home or while traveling.

To demonstrate this capability, this thesis develops a customized scenario designed to educate players in secrecy issues concerning the connection of an internal corporate network with the Internet. Additionally, this thesis produces SDFs designed to test the game engine to determine if it would produce results that met the SDF developer’s expectations and that the simulated game environment is realistic.

Keywords: Information Assurance, CyberCIEGE, Scenario Definition File, Network Security Training

Utilization of Web Services to Improve Communication of Operational Information

David S. Lowery-Captain, United States Marine Corps
B.S., Valdosta State University, 2001
Master of Science in Computer Science-September 2004
Advisors: Donald P. Brutzman, Department of Information Sciences
Curtis Blais, Modeling, Virtual Environments and Simulation Institute

Currently under development, the Global Information Grid (GIG) Enterprise Services (ES) is a suite of capabilities intended to provide improved user access to mission-critical data via Web-based and network technologies. Some of the problems of implementing such capabilities include non-uniform data formats,
incompatible run-time environments, and nonstandard proprietary applications, all of which block operational interoperability.

Web services are specifically designed to address the interoperability challenges of a service-oriented architecture (SOA) such as the GIG. SOAs are networked infrastructures that are designed to facilitate the interoperability of collections of services without requiring service context awareness. Standards-based Web services provide the necessary flexibility and extensibility to ensure that information flow is platform, run-time, and software independent.

The proof of concept (POC) software example developed for this research demonstrates the flexibility and extensibility of standards-based, operating-system-independent Web services. The result is an experimental endeavor to provide a mock operation command center information portal that provides a notional summary personnel status report to the commander in real-time from a Web service that was originally generated by a stand-alone client/server system. The POC is developed with great attention to open-source technologies and open-standards compliance. The key technologies involved are Extensible Markup Language (XML), the Java programming language, PHP: Hypertext Preprocessor (PHP) scripting language, and Simple Object Access Protocol (SOAP).

This work demonstrates the benefits of leveraging Web services to unlock legacy specialized applications to enhance the warfighter’s battlespace awareness by improving information flow via a Web-based information portal.


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INFORMATION SECURITY AND WIRELESS: ALTERNATE APPROACHES FOR CONTROLLING ACCESS TO CRITICAL INFORMATION

Winsome A. Nandram-Captain, United States Marine Corps
B.A., Campbell University, 1999
Master of Science in Computer Science—September 2004
Advisors: Gurminder Singh, Department of Computer Science
Arijit Das, Department of Computer Science

The advent of Wireless Local Area Networking (WLAN) has seen a widespread adoption of its technology and functionality in many different areas. Many studies show that more and more organizations are extending their networks to incorporate wireless devices and their applications. Permitting wireless devices to access private networks, however, further complicates the tasks of protecting the network and its resources from unauthorized access. Now that they have become a significant element in today’s networks, selecting and deploying adequate security measures have become the focus of many research efforts. Typically, network managers implement countermeasures to augment security.

The goal of this thesis is to research approaches that compliment existing security measures with fine grain access control measures. The Extensible Markup Language (XML) is adopted to accommodate such granular access control as it provides the mechanisms for scaling security down to the document content level.

KEYWORDS: Wireless Local Area Networking, WLAN, Networks, Wireless Devices, Extensible Markup Language, XML
COMPUTER SCIENCE

CODE MAINTENANCE AND DESIGN FOR A VISUAL PROGRAMMING LANGUAGE
GRAPHICAL USER INTERFACE
Graham C. Pierson-Major, United States Marine Corps
B.S., University of Puget Sound, 1989
Master of Science in Computer Science-September 2004
Advisor: Mikhail Auguston, Department of Computer Science
Second Reader: R. Scott Coté, Department of Computer Science

This work adds new functionality to an existing visual programming environment. It applies software maintenance techniques for use with the Java Language in a Microsoft Windows operating system environment. The previously undocumented application is intended to support programming with executable diagrams. This application has the potential to expand programming access to non-programmers, provide better software documentation, and improve software maintainability. It is currently capable of supporting meta-programming tasks such as parsing and compiler building. The 11,184 legacy lines of code (LOC) were corrected, extended, and documented to support future maintenance using an additional 957 LOC and changes to 45 LOC.


THE DISTANCE TRAINING SYSTEM (DTS) APPLICATION USING DREAMWEAVER MX2004 AND JSP APPLICATION SERVER TECHNOLOGY
Nikolaos Pogkas-Major, Hellenic Army
B.S., Hellenic Military Academy, 1990
Master of Science in Computer Science-September 2004
Advisors: Thomas Otani, Department of Computer Science
Arijit Das, Department of Computer Science

In recent years, declining budgets, limitations on military personnel and decreases in training areas have reduced the opportunity to conduct live military training. For these reasons, Distance Learning Systems are available for providing an almost realistic training platform for enlisted staff and officers.

This thesis has two main objectives. The first is the development of a data model that can be used as a central information repository for an unlimited number of authenticated users. The Distance Training System (DTS) application was developed using a hierarchical approach and is a Content Management System (CMS) appropriate for users desiring the benefit of accessing the contents of a database. The second objective is the exploration of the interaction between application server technologies, such as the JSP, with a Web development tool, such as Dreamweaver MX2004. This work focuses on the convenience of developing a fast and accurate web application product using HTML, as long as it results in a correct and clean data model. Other server technologies are also used as references, such as Active Server Page (ASP), Coldfusion, and PHP, which along with Java Servlet Pages (JSP), are the leading technologies in web database development for processing user events.

KEYWORDS: Distance Training System, DTS, Dreamweaver MX2004, JSP, Tomcat, MySQL, XML, CMS
The Naval Postgraduate School Center for Information Systems Security Studies and Research (CISR) is designing and developing a distributed multilevel secure (MLS) network known as the Monterey Security Architecture (MYSEA). MYSEA will permit the delivery of unmodified commercial-off-the-shelf productivity software applications and data from a large number of single-level network domains (e.g., NIPRNET, SIPRNET, JWICS) to a trusted distributed operating environment that enforces MLS policies. The analysis and development of a communications framework necessary to support connections between multiple MLS servers and a set of high assurance network appliances supporting simultaneous access to multiple single level networks and their concurrent connection management is required to fulfill the goal of MYSEA.

To enable this functionality, modifications to the existing MYSEA server, the development of a new high assurance communications security device (the Trusted Channel Module (TCM)), and the implementation of a trusted channel between the MYSEA server and the TCM are required. This document specifies a framework for incorporating the high level design of the TCM, several trusted daemons and databases, plus the incorporation of a trusted channel protocol into MYSEA to enable a distributed MLS environment.

**KEYWORDS:** Multilevel Security, Trusted Channel, High Assurance, Distributed MLS Network

Cyber-exercises coordinated over the Internet are an effective method of practicing cyber attack and defend techniques. The Virtual Private Network (VPN) is an effective way to link cyber attack and defend teams, providing for the encryption of exercise traffic that transits the public network infrastructure. However, VPNs and the technologies and devices behind them are not yet widely understood. Research and evaluation of VPN solutions will identify those most conducive to supporting a cyber exercise. Users demand a solution that is secure, reliable, and easy to employ. The research in this thesis applies directly to the selection and implementation of an optimal VPN solution to support cyber exercises.

**KEYWORDS:** Virtual Private Network, Cyber-exercise, IPSec, Encrypted Tunnels
RISK ASSESSMENT OF THE NAVAL POSTGRADUATE SCHOOL GIGABIT NETWORK
Todd A. Shumaker-DoD Civilian
B.S., California State University, 2003
Master of Science in Computer Science-September 2004
Dennis J. Rowlands-DoD Civilian
B.S., Indiana University of Pennsylvania, 2001
Master of Science in Computer Science-September 2004
Advisors: Karen Burke, Department of Computer Science
Craig Rasmussen, Department of Applied Mathematics
This research examines the current Naval Postgraduate School Gigabit Network security posture, identifies any possible threats or vulnerabilities, and recommends any appropriate safeguards that may be necessary to counter the identified threats and vulnerabilities. The research includes any portion of computer security, physical security, personnel security, and communication security that may be applicable to the overall security of both the .mil and .edu domains. The goal is to ensure that the campus network is operating with the proper amount of security safeguards to protect the confidentiality, integrity, availability, and authenticity from both insider and outsider threats. Risk analysis is performed by assessing all of the possible threat and vulnerability combinations to determine the likelihood of exploitation and the potential impact the exploitation could have on the system, the information, and the mission of the Naval Postgraduate School. The results of the risk assessment performed on the network may be used by the Designated Approving Authority of the Naval Postgraduate School Gigabit network when deciding whether to accredit the system.

KEYWORDS: DITSCAP, Certification, Accreditation, Information Assurance, SSAA, Risk Assessment, Threat, Vulnerability, Risk, Countermeasure

AN ARCHITECTURAL FRAMEWORK FOR DESCRIBING SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS
Michael P. Ward-Captain, United States Marine Corps
B.S., College of William and Mary, 1989
Master of Science in Computer Science-September 2004
Advisors: Cynthia E. Irvine, Department of Computer Science
Deborah S. Shifflett, Department of Computer Science
Second Reader: Daniel F. Warren, Department of Computer Science
Two recent trends have raised concerns about the security and stability of Supervisory Control and Data Acquisition (SCADA) systems. The first is a move to define standard interfaces and communications protocols in support of cross-vendor compatibility and modularity. The second is a move to connect nodes in a SCADA system to open networks such as the Internet. Recent failures of critical infrastructure SCADA systems highlight these concerns. To ensure continued operations in times of crisis, SCADA systems, particularly those operating in critical infrastructures, must be secured. Developing an abstract generic framework for defining and understanding SCADA systems is a necessary first step. A framework can provide the tools to understand the system's functions and capabilities, and how components in the system relate and interface with each other. This thesis examines and describes SCADA systems, their components, and commonly used communications protocols. It presents a matrix approach to describing and defining the features, functions, and capabilities of a SCADA system. Two small SCADA systems, using industry standard components and simulating real world applications, are designed and constructed for this thesis to provide context for applying the matrix approach.

KEYWORDS: Supervisory Control and Data Acquisition, SCADA, Critical Infrastructure Protection, CIP
UNDERSTANDING THE MILITARY’S ROLE IN ENDING STATE-SPONSORED TERRORISM

Kevin R. Arthur-Major, United States Air Force
B.S., United States Air Force Academy, 1990
M.A., Webster University, 1998
Master of Science in Defense Analysis-September 2004
Advisors: David C. Tucker, Department of Defense Analysis
Frank R. Giordano, Department of Defense Analysis

Countries sponsoring and supporting terrorism impede the efforts of the United States and the international community to fight terrorism. Until states that support terrorism cease such sponsorship, they remain a critical foundation for terrorist groups and their operations. The purpose of this thesis is to examine the U.S. military’s role in coercing states to cease their sponsorship of terrorism. Using game theory, this thesis analyzes the utility of military force against state-sponsored terrorism. It explains why past military responses did not pose a credible threat and were thus an ineffective instrument of national power. It then examines how military force is employed in the current War on Terrorism. The findings of this thesis suggest that the limited military strikes employed against states for their role in terrorist attacks prior to September 11, 2001, preconditioned the leaders of states supportive of terrorism to believe U.S. leadership lacked commitment in its strategy to end state-sponsored terrorism. The findings also suggest the dramatic change in the United States’ method of employing its military forces against state sponsors of terrorism after September 11, 2001, created the credible, coercive military threat required to accomplish the U.S. national objective of ending state-sponsored terrorism.

KEYWORDS: State-sponsored Terrorism, Counterterrorism, Rational Actor, Operation El Dorado Canyon, Operation Infinite Reach, U.S.S. COLE, Game Theory

CONVERGENCE AND RELIGIOUS TERRORISM IN AMERICA

Christopher B. Ashby-Major, United States Air Force
B.A., University of Illinois, 1989
Master of Science in Defense Analysis-September 2004
Gregory S. Brinsfield-Major, United States Air Force
B.S., Southwest Texas State University, 1989
Master of Science in Defense Analysis-September 2004
Advisor: Anna Simons, Department of Defense Analysis
Second Reader: George Lober, Department of Defense Analysis

Religious terrorism, as most recently highlighted by the horrendous 9/11 attacks, is not a new phenomenon. It is not restricted to any one particular religion or belief system, nor is it reserved as a weapon against foreign lands. Domestic religious terrorism is just as prevalent throughout history and is brought about by the convergence of certain socio-economic factors and new or modified technologies. Under these conditions, a charismatic leader with an appealing ideology and access to sufficient resources may become a very powerful threat to society, pitting the secular against the divine. This type of convergence may result in altogether new religious movements or the unexpected growth of fringe groups that, until they act, are not even identified.

Examining the historical convergences of the Reformation, First and Second Great Awakenings, and the trends of modern domestic society, it is found that the threads which hold these movements together remain consistent throughout history. Enabled by the rapid growth of technology, these groups have unprecedented potential power. A group that decides to become offensive or use weapons of mass destruction, such as Japan’s Aum Shinrikyo, may pose an unacceptable risk to the country.
This study examines the significant issues relative to e-commerce and how e-commerce has resulted in protests, disputes, and litigation in the federal acquisition process. Issues regarding the evolution of e-commerce since the October 1993 mandate by former President Clinton, particularly how it relates to the Department of Defense Acquisition Workforce, are considered in this thesis. Authors specifically address the traditional acquisition process versus the contemporary process in relation to Electronic commerce, and the tools utilized by the Acquisition Workforce to accomplish their buying activities.

**KEYWORDS:** Electronic Commerce, Federal Business Opportunities, Government Purchase Card, Government-wide Point of Entry, Electronic Data Interchange
THE ADVENT OF THE NATO RESPONSE FORCE AND ITS POTENTIAL EFFECT ON THE UNITED STATES AIR FORCE

John A. Branin-Major, United States Air Force
B.A., University of Maine, 1989
M.A., Webster University, 1997
Master of Science in Defense Analysis-September 2004
Advisor: George Lober, Department of Defense Analysis
Second Reader: Anna Simons, Department of Defense Analysis

The advent of the NATO Response Force (NRF) is the result of the call for NATO to create a warfighting capability to meet the security threats of the 21st Century. The NRF is a joint force comprised of air, land and maritime assets designed to conduct operations across the full spectrum of conflict. Missions include opposed entry scenarios, counter-terrorism, crisis response, peace enforcement, embargo operations, interdiction and human relief and non-combatant evacuations, meeting the need identified in the U.S. National Security Strategy as well as the European Union Security Strategy. The NRF also serves as a catalyst for transformation, encouraging European nations to downsize and retool their legacy forces in order to participate in the NRF. Political influences and operational constraints threaten to limit the NRF. The tangible effect the NRF will have on the Air Force will be its disproportionate need for Air Force assets to meet its required operational mandate. The result of the EU’s inability to readily address their capability shortfalls will be the NRF’s dependence upon Air Force to provide strategic airlift, air refueling, Intelligence, Surveillance and Reconnaissance (ISR), and the procurement and use of Precision Guided Munitions (PGMs) for the foreseeable future.


A COUNTER INSURGENCY STUDY: AN ANALYSIS OF LOCAL DEFENSES

Sergio M. Giampietri-Lieutenant Commander, Peruvian Navy
B.C.H.M., Peruvian Naval Academy, 1990
M.B.A., University of San Ignacio, 1998
Master of Science in Defense Analysis-December 2004
Advisor: Gordon H. McCormick, Department of Defense Analysis
Second Reader: George Lober, Department of Defense Analysis

Local defenses are viewed by many counterinsurgency strategists as an essential element in defeating an insurgency. Providing a population with a local defense organization will strongly support the government’s strategy of extending its security and control over the rural areas affected by insurgent organizations. Every insurgency is unique and demands a unique counterinsurgency strategy in order to defeat it. However, there will always be an important commonality: insurgent organizations need popular support to subsist. The final success of either the government or the insurgents will be determined by the capacity to both to win and retain support among the rural population.

The analysis of four cases presented in this study clearly demonstrates each government’s approach to the insurgent problem, including the use of local defenses to protect rural populations from insurgent attacks and influence. The organization of local defenses during the Malayan Emergency, El Salvador’s Civil War, the Vietnam War, and the Terrorist Epoch in Peru proved to be a force multiplier for the government, at least during the time period in which the local defenses were effectively implemented. The contribution of this analysis rests not on providing a framework or recipe for strategists to implement this
kind of organization, but rather on the identification of a set of variables to be considered when planning the implementation of local defenses as part of a counterinsurgency effort.

KEYWORDS: Popular Support, Local Defenses and Effectiveness

SWIMMING WITH THE NATIVES: CULTURAL IMMERSION AND ITS APPLICATIONS FOR NAVAL SPECIAL WARFARE
Matthew J. Jackson-Lieutenant Commander, United States Naval Reserve
B.A., B.S., San Diego State University, 1990
Master of Science in Defense Analysis-September 2004
Advisor: Anna Simons, Department of Defense Analysis
Second Reader: George Lober, Department of Defense Analysis

The new enemy hides in the shadows of anonymity. As of September 11, 2001, combat in today’s world is much more challenging and requires a better understanding of the enemy and its support infrastructure. There is a renewed interest in human intelligence (HUMINT) as expressed by the U.S. Department of Defense and the various U.S. intelligence collection agencies. But HUMINT is only data collected by human sources about an individual or group of individuals and their activities. Cultural immersion is a step above mere data collection in that it allows its practitioners to understand the thought processes and/or routines of the individuals or groups in question.

This thesis examines the various aspects of cultural immersion and how they relate to warfare, and proposes recommendations for cultural immersion in support of present day Naval Special Warfare (NSW) missions. The intent is to provide decision-makers a viable option for actionable intelligence gathering during the Global War on Terrorism.

KEYWORDS: Cultural Immersion, Cultural Awareness, Human Intelligence, HUMINT, Social Networks, Intelligence Networks, Actionable Intelligence, Language Skills, Direct Action, Special Reconnaissance, Unconventional Warfare, Combating Terrorism, Information Operations, Intelligence Preparation of the Battlespace, Operational Preparation of the Battlespace, Regional Expertise

ELECTRONIC WARFARE: A CRITICAL MILITARY AND TECHNOLOGICAL ASSET FOR THE IMPROVEMENT OF THE COMMON EUROPEAN SECURITY AND DEFENSE POLICY (ESDP)
Ilias Panagopoulos-Major, Hellenic Air Force
B.S., Hellenic Air Force Academy, 1988
Master of Science in Systems Engineering-September 2004
Master of Science in Defense Analysis-September 2004
Advisors: Donald Wadsworth, Department of Electrical and Computer Engineering
Robert Looney, Department of National Security Affairs

Since the Maastricht Treaty, the European Union (EU) operates under three key pillars. The second pillar, known as the Common Foreign and Security Policy (CFSP), introduced the need among member states to develop a common European Security and Defense Policy (ESDP). Aimed at providing police and military capabilities to the CFSP, this idea represented a new and important element in the progress of European integration. ESDP was launched formally in June 1999, with the establishment of ESDP’s mission roots, known as the three “Petersberg Tasks”: (1) Humanitarian and Evacuation Missions, (2) Peace Keeping Missions, and (3) Combat Missions for Crisis Management. The aim of the EU was to upgrade its role and influence in the international arena, though with no intention of overtaking NATO’s role in the field of collective defense. The purpose of this thesis is to demonstrate the perspectives for the development of European Security and Defense Policy and to stress the need to consider Electronic Warfare (EW) a critical asset in the military and technological capability options. The need for common operational concepts, doctrines, and training, especially in the field of EW, becomes a necessity as Joint EU Armed Forces report active and ready to manage regional and international crises. However, the study of ESDP’s current status shows that EW, an important military component, has been addressed but not emphasized properly. In order to demonstrate EW’s “weight,” an imaginary scenario named “Save Atlantia 2008” has been created.
DEFENSE ANALYSIS

in which an advanced software program (i.e., IMOM model) simulates EW effects. The Improved Many-on-Many (IMOM) computer software, presently used by the U.S. Air Force to model the Electronic Order of Battle (EOB), will be used to model the Radar and Tactical Jamming System and conclusions will be based on the theoretical expected jamming effectiveness of the Joint European Air Force against several radar systems in the imaginary scenario.

KEYWORDS: European Union, EU, European Security and Defense Policy, ESDP, NATO, Electronic Warfare, EW, IMOM Model

ANATOMY OF A HOSTAGE RESCUE: WHAT MAKES HOSTAGE RESCUE OPERATIONS SUCCESSFUL?
Carlos M. Perez-Major, United States Army
B.S., University of Miami, 1991
Master of Science in Defense Analysis-September 2004
Advisor: Gordon H. McCormick, Department of Defense Analysis
Second Reader: Frank R. Giordano, Department of Defense Analysis
Third Reader: Peter J. Gustaitis, Department of Defense Analysis

This thesis develops a theory to determine the best execution time to conduct a hostage rescue attempt. It does so by explaining the phenomenon of a hostage crisis biorhythm and proposing four principles essential for success. The principles of hostage rescue operations presented in this thesis and used in the biorhythm model—surprise, intelligence, operator’s skill, and deception—are derived from looking at numerous planning models from special operations, the author’s experience, and the thorough analysis of six historical cases. The historical cases show that in every instance where any one of these four principles was overlooked, the operation was doomed. These principles have been determined to be the most critical factors that change as the crisis develops throughout the hostage ordeal. A thorough understanding of this biorhythm will provide planning guidelines to assess the best windows of opportunity for a proposed rescue attempt.

One main focus of this work is an in-depth case study of the hostage rescue operation “CHAVIN DE HUANTAR.” This case study presents compelling evidence to reinforce the hypothesis of this thesis, and serves as a template model for successful rescue operations. The analysis of this single case provides a wealth of information on the success of this remarkable operation. Another main focus of this thesis is strategic thinking of a hostage crisis using game theory analysis.

The findings of this thesis enable decision-makers to plan and organize hostage rescue forces to act at the appropriate time (window of opportunity), maximizing their chances of success. Additionally, it provides a useful planning model that can be implemented effectively and accurately, presenting a clear picture of possible outcomes throughout a hostage crisis. Furthermore, this thesis helps the reader become a better strategist during the planning, preparation, and execution of a hostage rescue operation. It provides a thorough understanding of how these operations work, how to solve them successfully, and how to predict possible outcomes at different stages of the operation applying the principles of game theory.

KEYWORDS: Operation CHAVIN DE HUANTAR, Hostage Rescue, Game Theory, Special Operations, SOF, CQB, EAGLE CLAW, DESERT ONE, Tehran, Iran, Lima, Peru, FIRE MAGIC, MUNICH OLYMPICS, DE PUNT TRAIN HIJACKING, FORCE 777, Egypt, Malta, Somalia, Mogadishu, McRaven, GSG-9, Strategic Thinking, John Nash, Biorhythm, BBE, Dozier
The significance of the Radar Cross Section (RCS) in the outcome of military engagements makes the prediction of RCS an important problem in modern Electronic Warfare. The PO FACETS program, previously developed at the Naval Postgraduate School (NPS), uses the Physical Optics method to predict the RCS of complex targets, which are modeled with the use of triangular facets. The program has minimum computer resource requirements and provides convenient run-times. This thesis upgrades, enhances, and expands the functionalities and capabilities of the PO FACETS program. The new functionalities are implemented by upgrading the Graphical User Interface and model database, allowing the creation of models with an unlimited number of facets, providing capabilities for the automatic creation of models with standard geometric shapes, allowing the combination of existing target models, providing capabilities for sharing target models with commercial CAD programs, and creating new display formats for RCS results. The new computational capabilities include the development of a user-updateable database of materials and coatings that can be applied to models in one or multiple layers, and the computation of their effects on the models’ RCS. Also implemented are the computations of the ground’s effect on the RCS, and the exploitation of symmetry planes in models, in order to decrease run-time for RCS prediction.

**KEYWORDS:** Physical Optics, Radar Cross Section, Monostatic, Bistatic, Electromagnetic Scattering, Graphical User Interface, Faceted Models

The effects of radiation in GaAs solar cells have been extensively researched and the results of numerous investigations have yielded a considerable amount of information about the degradation in irradiated solar cells. This thesis establishes a novel method in which to use Silvaco's physically-based device simulator, ATLAS, to model the effects of radiation on solar cell output characteristics. A virtual model representing a single junction GaAs solar cell is created in ATLAS. The effects of radiation are modeled using carrier trapping statements representing the defects associated with various fluence levels of 1 MeV electron radiation, which are characterized with Deep Level Transient Spectroscopy techniques. The resulting output characteristics of the virtual solar cell, illuminated with a simulated AM0 spectrum, are compared to published experimental measurements for GaAs solar cells of the same dimensions. The virtual solar cell demonstrates a good correlation between the measured and virtual solar cell output characteristics and accurate representation of the spectral response. Complete ATLAS and MATLAB codes are included in appendices.
SIMULATING RADIATION-INDUCED DEFECTS ON SEMICONDUCTOR DEVICES

Dewey Clinton Gladney-Lieutenant, United States Navy
B.S., Southern University and A&M College, 1997
Master of Science in Electrical Engineering-September 2004
Advisor: Sherif Michael, Department of Electrical and Computer Engineering
Second Reader: Todd R. Weatherford, Department of Electrical and Computer Engineering

Exploring semiconductor lifetime, reliability, and performance is a never-ending science in today’s modern electronics. One significant problem that affects all of these areas is radiation-induced damage. Calculations must be made to determine system lifetime of semiconductor devices in radiation-harsh operational environments. Today’s high-technology investments in such areas as satellite design, medical advances, military and commercial hardware demand thorough understanding of radiation damage. Modeling semiconductor devices with computer-based simulation will provide cost and time savings over a repetitive design and testing sequence.

This thesis models and simulates an industry standard solar cell and a light emitting diode (LED), using the SILVACO ATLASTM computer-based program. Using this software, these simulations are generated based on known radiation-induced defects on gallium arsenide (GaAs) semiconductive devices derived from Deep Level Transient Spectroscopy (DLTS) studies. A comparison is then made with another radiation-induced damage prediction method, known as Non-Ionizing Energy Loss (NIEL), to determine if the SILVACO ATLASTM models can be used as an alternative.

KEYWORDS: Radiation, GaAs Solar Cells, GaAs Semiconductors, Semiconductors

NPSAT1 MAGNETIC ATTITUDE CONTROL SYSTEM ALGORITHM VERIFICATION, VALIDATION, AND AIR-BEARING TESTS

Eric W. Herbert-Lieutenant Commander, United States Navy
B.A., Pennsylvania State University, 1991
M.S., Naval Postgraduate School, 1998
Master of Science in Electrical Engineering-September 2004
Advisors: Barry S. Leonard, Department of Mechanical and Astronautical Engineering
Xiaoping Yun, Department of Electrical and Computer Engineering

NPSAT1 is a gravity-gradient friendly, prolate body designed to fly at 600 ± 40 km inclined to 34.5 degrees. The satellite uses a magnetic 3-axis active attitude control system (ACS) using magnetic torque rods that interact with the earth’s magnetic field. This thesis accomplishes three objectives.

The first objective is to verify and validate the magnetic attitude control system program and model developed by Leonard. The verification and validation process is completed in two steps. The first step accomplishes an independent modeling of the earth’s magnetic field using MATLAB. The second step completes verification via inspection of Leonard’s ACS SIMULINK model. The verification confirms that Leonard’s modular sub-components of the disturbance torques, the quaternion vectors, the Euler angles, the spacecraft kinematics and dynamics and ACS control laws conform to current ACS empirical theory.

The second objective of this thesis is to establish a laboratory to be used to demonstrate the ACS robustness and ability to perform as designed. The laboratory was created to house an air-bearing platform that simulates NPSAT1 characteristics.

The third objective is to perform hardware-in-the-loop experiments with the NPSAT1 ACS software and model. Hardware-in-the-loop tests were performed to the magnetic torque rods, torque rod driver circuit board, micro-controller computer, and control interfaces. Specifically, solenoid current tests, magnetic field determination tests, and digital-to-analog conversion tests are completed.

KEYWORDS: Magnetic Attitude Control, Torque Rods, 3-Axis Active Control, Magnetometers, Earth Magnetic Field, Steering Control Law, Bdot Control Law, Quaternion, Small Satellites, Low Earth Orbit Satellites, Hardware-in-the-Loop, Air-bearing
On the modern battlefield, successful and fast communications is a critical issue, thus increasing the need for transmitting information in larger amounts through a military high-speed network. The military is seeking viable and effective solutions to fulfill these requirements in an operational environment.

This thesis develops a prototype system based on appropriate low-cost software and hardware solutions. This system is able to detect, analyze, and process wireless 802.11g signals. The evaluation of the newly designed system proves that it is effective up to distances of about 400 meters with a low packet error rate and could be a useful tool for detecting wireless 802.11g networks. After evaluating the system, it is used for capturing wireless signals so that the effective transmission range and the data throughput of an 802.11g network could be assessed. It is determined that such a wireless network could be used in military operations because it offers high data rates up to 200 meters, while maintaining a connection of the wireless clients for distances up to 400 meters. In addition, the performance data collected can be used as guidelines for estimating the expected performance in an operational situation and can provide useful information for successful planning.

KEYWORDS: Wireless Transmission Protocol, IEEE 802.11g, Wireless LAN, Data Throughput, Transmission Rate

A study of Synchronous Optical Network (SONET) management applications and the load they impart to the network is conducted to provide a better understanding of the capability of various management approaches. In this study, a SONET network is set up in the Advanced Networking Laboratory of the Naval Postgraduate School using four Cisco ONS 15454s. Next, two Element Management Systems, the Cisco Transport Controller and the Cisco Transport Manager, are deployed onto the SONET network. Subsequently, the network traffic of the Element Management Systems is captured and analyzed using a packet analyzer. Link utilization of the two tools is computed using first-order statistics of the captured traffic distributions. In addition, the Hurst parameter is estimated using the variance-index plot technique (which uses higher orders statistics of the modeled distributions) to determine the captured traffic’s degree of self-similarity. Finally, the calculated utilization is extrapolated to obtain the link utilization for 2500 network elements (the maximum number supported by the Cisco Transport Manager). The result obtained is useful in determining the maximum number of network elements (Cisco ONS 15454s) that the Cisco Transport Manager can support from a network loading point of view.

KEYWORDS: Cisco Transport Controller, Cisco Transport Manager, Element Management Systems, Network Management, SNMP, SONET, SDH, Optical Networks, Self-similarity, Queuing Theory, Traffic Analysis
EVALUATION AND TESTING OF THE NAVAL POSTGRADUATE SCHOOL SATELLITE (NPSAT1) SOLAR CELL MEASUREMENT SYSTEM

Benson W. Lo-Ensign, United States Naval Reserve
B.S., University of California-Los Angeles, 2003
Master of Science in Electrical Engineering-September 2004
Advisor: Sherif Michael, Department of Electrical and Computer Engineering
Second Reader: Herschel H. Loomis, Jr., Department of Electrical and Computer Engineering

The Naval Postgraduate School Spacecraft Architecture and Technology Demonstration Satellite, NPSAT1, launching in fall 2006, will include a system to measure the performance of new experimental triple-junction solar cells. The measuring circuit in the Solar Cell Measurement System (SMS) is based on a circuit developed at the Naval Postgraduate School many years ago. It will trace the cells’ current-voltage (I-V) curves while in orbit. The SMS consists of a radiation-hardened microcontroller that uses a radiation-hardened field programmable gate array (FPGA) to monitor a collection of sensors. A current-sink circuit is used to measure the current and voltage on the test cells. Prior to launch, extensive testing is being performed on the system to ensure proper operation. The tests consist of taking cell measurements while subjecting solar cells and the measuring circuit electronics to conditions modeling the space environment. This thesis presents the mission information, system design, test setup, and test results of the SMS measuring circuit.

KEYWORDS: NPSAT1, Solar Cell, Solar Cell Measurement, Triple Junction, SMS, I-V Curve, Solar Simulator

A COMPARISON OF TIMING METHODS IN ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM) SYSTEMS

Ersoy Oz-First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1999
Master of Science in Electrical Engineering-September 2004
Advisors: Roberto Cristi, Department of Electrical and Computer Engineering
Murali Tummala, Department of Electrical and Computer Engineering

Orthogonal frequency division multiplexing (OFDM) is being used by wireless local area network (WLAN) standards, such as IEEE 802.11a, and wireless metropolitan area network (MAN) standards, such as IEEE 802.16a. OFDM is a very efficient communications scheme for wireless ad hoc networks. However, the wireless environment causes inter-symbol interference (ISI) and inter-carrier interference (ICI). Estimating the starting point of an OFDM symbol must be handled efficiently and effectively to reduce the errors. OFDM must be time synchronized to prevent inter-symbol interference (ISI) and inter-carrier interference (ICI). Many techniques exist to realize timing synchronization in OFDM systems. In this thesis, the need for timing synchronization, the timing errors and the performance of different techniques under a variety of mobile channel models (indoor and outdoor) are investigated, and simulation performance results for each technique under different channel models are presented.

KEYWORDS: Orthogonal Frequency Division Multiplexing, OFDM, Timing Offset, Coarse Timing Synchronization, Fine Timing Synchronization, Differential Decoding, IFFT, Inverse Fast Fourier Transform, Cyclic Prefix, FFT, MATLAB, Additive White Gaussian Noise, AWGN, Mobile Channels, Probability of Bit Error
This thesis examines the performance of the waveforms specified by the IEEE 802.11a wireless local area network standard, when the signal is transmitted over a Ricean fading channel with additive white Gaussian noise (AWGN) and pulsed-noise interference. The pulsed interference is assumed of constant power and is either fading or non-fading. The probability of bit error is conditional on the received signal-to-noise power ratio, which is modeled as a random variable. The probability density function of this variable is obtained analytically or numerically for each modulation type and the probability of bit error is evaluated as the expected value of the conditional probability. In one case, a new technique is used to evaluate the inverse Laplace transform in order to evaluate numerically the signal-to-noise ratio probability density function. Due to the complexity of the analysis when both the signal and the interference are subject to Ricean fading, the evaluation was simplified by assuming Ricean signal fading with Rayleigh interference fading and vice versa. The results of the analysis show that performance is affected by the degree of signal fading and also depends on the pulsed interference duty cycle. The signal-to-interference power ratio affects the way performance depends on these two factors.


The objective of this thesis is to investigate the requirements and limitations of boost phase ballistic missile intercept systems that contain an interceptor and its guidance sensors (both radar and infrared). A three-dimensional computer model is developed for a multi-stage target with a boost phase acceleration profile that depends on total mass, propellant mass and the specific impulse in the gravity field. The radar cross-section and infrared radiation of the target structure are estimated as a function of the flight profile. The interceptor is a multi-stage missile that uses fused target location data provided by two ground-based radar sensors and two low earth orbit infrared sensors. Interceptor requirements and limitations are derived as a function of its initial position from the target launch point and the launch delay. Sensor requirements are also examined as a function of the signal-to-noise ratio during the target flight. Electronic attack considerations within the boost phase are also addressed, including the use of decoys and noise jamming techniques. The significance of this investigation is that the system components within a complex boost phase intercept scenario can be quantified and requirements for the sensors can be numerically derived.

**KEYWORDS:** Boost-Phase Ballistic Missile Intercept, Modeling, Simulation, Missile Requirements, Sensor Requirements, Electronic Attack Effects, Proportional Navigation, Radar Cross Section, IR Energy Radiation Estimation, RF Sensors, IR Sensors, Data Fusion, Decoys, Noise Jamming
With the rapid employment of commercial wireless networks, the military is seeking viable solutions for providing a high-speed wireless network throughout the battle space. The IEEE 802.11a wireless local area network (LAN) presents an attractive solution providing up to 54 Mbps data-link bandwidth. Moreover, it operates in the less congested 5-GHz U-NII band and possesses more operating channels.

This research implemented two prototype systems using low-cost commercially available hardware. The Cisco Aironet 1400 wireless bridge and the Proxim Tsunami MP.11a wireless system were chosen for their superior specifications and for their reputation as market leaders in IEEE 802.11 wireless products. The performances of the prototype systems were evaluated in three operational environments (land, water, and vegetation). The data collected were then compared to the theoretical performance.

KEYWORDS: Wireless Transmission Protocol, IEEE 802.11a, Wireless LAN
Acoustic propagation in the littoral regions of the world, even over short ranges, can be complex at high frequencies (> 5 kHz), and applications such as underwater detection and communications suffer as a result. To this end, the Asian Seas International Acoustics Experiment (ASIAEX) was conducted with funding from the Office of Naval Research.

One phase of this experiment took place from 29 May to 9 June 2001, and focused on short-range, shallow water acoustic propagation in the East China Sea. This thesis is based on some of the measurements taken during the East China Sea experiment by a team from the Applied Physics Laboratory of the University of Washington. The environmental parameters and array geometry used in this and previous modeling work are as close as possible to the experiment.

The objective of this thesis is to better understand the nature of turbulent perturbations and how they affect short-range acoustic propagation in a shallow water environment. This includes variations in total energy of the turbulence, variations in associated length scales and variations in depth. In addition, the influence of other variable factors on signal coherence is examined. Most notably, variations in background sound-speed structure and source depth variability are included.

KEYWORDS: Shallow Water Variability, Turbulence, Vertical Coherence, Sound Speed Curvature
AUTOMATED PSYCHOLOGICAL CATEGORIZATION VIA LINGUISTIC PROCESSING SYSTEM
Mark D. Eramo-Captain, United States Marine Corps  
B.S., University of Kansas, 1996  
Master of Science in Information Technology Management-September 2004  
Master of Science in Information Systems and Operations-September 2004  
Christopher M. Sutter-Lieutenant, United States Navy  
B.S., Hampden-Sydney College, 1996  
Master of Science in Information Technology Management-September 2004  
Master of Science in Information Systems and Operations-September 2004  
Advisors: Raymond Buettner, Department of Information Sciences  
Magdi N. Kamel, Department of Information Sciences

Influencing one’s adversary has always been an objective in warfare. To date, however, the majority of influence operations have been geared towards the masses or to very small numbers of individuals. Although marginally effective, this approach is inadequate with respect to larger numbers of high value targets and to specific subsets of the population. Limited human resources have prevented a more tailored approach that would focus on segmentation, because individual targeting demands significant time from psychological analysts. This research examines whether or not Information Technology (IT) tools, specializing in text mining, are robust enough to automate the categorization/segmentation of individual profiles for the purpose of psychological operations (PSYOP). Research indicates that only a handful of software applications claim to provide adequate functionality to perform these tasks. Text mining via neural networks is determined to be the best approach given the constraints of the profile data and the desired output. Five software applications are tested and evaluated for their ability to reproduce the results of a social psychologist. Through statistical analysis, it is concluded that the tested applications are not currently mature enough to produce accurate results that would enable automated segmentation of individual profiles based on supervised linguistic processing.

KEYWORDS: Text Mining, Data Mining, Automated Psychological Categorization, Automated Psychological Segmentation, Linguistic Processing, Automated Linguistic Processing, Precision Influence, Automated Precision Influence, Information Operations, Influence Operations, Psychological Operations, PSYOP

ANALYZING THE DESIGN OF TERRORIST ORGANIZATIONS: USING THE ORGANIZATIONAL CONSULTANT
Harrison T. Lowe-Lieutenant Junior Grade, United States Naval Reserve  
B.S., Florida State University, 2001  
Master of Science in Information Systems and Operations-September 2004  
Advisor: Carl Jones, Professor Emeritus of Information Sciences  
Second Reader: Raymond Buettner, Department of Information Sciences

With the events of September 11, 2001, terrorist organizations have moved to the forefront of threats to U.S. national security. These organizations utilize unconventional forms of warfare and new organizational structures to survive. However, they must still perform all the functions of traditional organizations: fundraising, internal and external communications, command and coordination, creation of a product, etc. Using an expert system to evaluate the structure of a terrorist organization could increase the amount of knowledge and understanding of that organization and could provide critical insights into the organization’s strengths and vulnerabilities. This research evaluates the expert system Organizational
Consultant to evaluate the Hamas terrorist organization as a case study.

In order to combat terrorism effectively, the U.S. must gather as much knowledge about various terrorist organizations as possible. Using fit criteria and certainty factors to analyze an organization by means of the expert system Organizational Consultant, the Department of Defense could potentially gain a powerful understanding of the organization’s strengths and weaknesses and utilize that knowledge to bring about the terrorist organization’s demise efficiently and effectively.

**KEYWORDS:** Organizational Design, Organizational Theory, Organizational Consultant, Expert Systems, Decision Systems, Hamas, Terrorism
MASTER OF SCIENCE
IN
INFORMATION TECHNOLOGY MANAGEMENT

REDUCING THE TIME AND EXPENDITURE: FROM PROTOTYPE TO PRODUCTION IN INFORMATION TECHNOLOGY APPLICATION DEVELOPMENT
Aaron D. Abdullah-Captain, United States Marine Corps
B.S., Iowa State University, 1997
Master of Science in Information Technology Management-September 2004
Robert A. Campbell-Lieutenant, United States Navy
B.S., University of Maryland, 1997
Master of Science in Information Technology Management-September 2004
Samuel L. Ruble-Major, United States Marine Corps
B.S., Middle Tennessee State University, 1989
Master of Science in Information Technology Management-September 2004
Advisor: Thomas J. Housel, Department of Information Sciences
Second Reader: Richard D. Bergin, Department of Information Sciences

The Department of Defense (DoD) environment is constantly changing to keep up with highly sophisticated technology that is increasingly creating a global environment and to combat recent international terrorism threats. DoD technology must continue to evolve with modern demands in order to remain effective in today's dynamic and unpredictable environment. Therefore, new demands in software development are constantly increasing to fulfill the needs of rapidly changing business processes. The DoD is slowly becoming more automated and innovative to meet these new demands; however, current software development methodologies provide only limited support and their use often results in increased costs, changes in project scope/duration, and a reduction in system reliability and interoperability. Significant budget constraints and decreasing software development lead times present the need for higher levels of system reliability and interoperability. The goal of this thesis is to make DoD software development more efficient by decreasing the necessary time and expense for development by adopting an approach that will go straight from prototype to production.

KEYWORDS: Information Technology Management, Prototyping, CNRNW, Bachelor Housing, Prototype to Production, Application Development

WIRELESS TOOL KIT FOR HAND HELD DEVICES
Venkateshwaraiyer S. Baalaji-Major, Indian Air Force
B.E., Madurai Kamaraj University, 1991
Master of Science in Information Technology Management-September 2004
Advisors: Gurminder Singh, Department of Computer Science
Alexander Bordetsky, Department of Information Sciences

In this thesis, a tool kit for Hand held wireless devices is built. The software builds a tool kit which uses the User Datagram Protocol (UDP) and the multicasting principle. This toolkit can be used to create an agent which acts as a client or a listener. The functionality of the listener is to listen for registration messages and accept new clients into a conversation. Once the clients are registered, they can then transfer messages to all other registered clients and also save messages. The functionality of the client is to send and receive different kinds of messages.

KEYWORDS: Media Access Protocols, Ad Hoc Routing Algorithms, Ad Hoc Service Discovery
AN ANALYSIS OF THE FEASIBILITY AND APPLICABILITY OF IEEE 802.X WIRELESS MESH NETWORKS WITHIN THE GLOBAL INFORMATION GRID

Eric J. Bach-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1993
Master of Science in Information Technology Management-September 2004

Mark G. Fickel-Lieutenant Commander, United States Navy
B.S., South Dakota School of Mines and Technology, 1987
Master of Science in Information Science Technology-September 2004

Advisor: Alexander Bordetsky, Department of Information Sciences
Second Reader: Brian D. Steckler, Department of Information Sciences

This thesis analyzes the feasibility, functionality, efficacy, and usability of IEEE 802.x wireless mesh networks in multiple Department of Defense (DoD) contexts. Through multiple field and lab experiments and hardware investigations, an assessment is performed on the realistic implementation issues of wireless mesh networks and their possible applications. A detailed examination is conducted of the variable elements, operational constraints, and possible decision points for developing a usable, robust, self-organizing, wireless mesh network that can be leveraged for maximum usability and shared situational awareness in network-centric operations. This research investigates the suitability of currently available commercial-off-the-shelf hardware and software wireless mesh networking components for geographically distributed networks. Additionally, a product-line software architecture and a common data interchange Extensible Markup Language (XML) vocabulary are proposed as the enabling technology elements to carry application layer mesh forward for integration of collaborative sensor-decision maker adaptive networks within the Global Information Grid. The thesis includes the design and implementation of the first Naval Postgraduate School testbed for tactical level mesh networking with unmanned vehicles, unattended sensors, and warrior networking nodes. This thesis also lays the groundwork for further research into lower Open Source Initiative (OSI)-layer routing protocols for DoD mesh networks, development of mesh-aware applications, and a GIG-wide mesh network architecture.


INPUT AND TRACKING OF CONTINUED EDUCATION UNIT AND QUALIFICATION DATA FOR INFORMATION PROFESSIONAL (IP) COMMUNITY

LaShandra M. Beard-Lieutenant, United States Navy Reserve
B.S., Clark Atlanta University, 1995
Master of Science in Information Technology Management-September 2004

Advisor: Dan C. Boger, Department of Information Sciences
Second Reader: CDR Chris Vance, USN, Department of Information Sciences

The objective of this research is to provide recommendations and guidelines for building and maintaining a comprehensive Continuing Education Units (CEU) and qualification tracking system specifically for the Continuing Education Units (CEU) and Qualification program. The guidance includes topics ranging from designing, managing, and implementing a tracking program, through post-implementation of the program. This research includes the training needs of all personnel within the IP community, from users to supervisors to executive-level managers, including designated sponsors/mentors and external subject matter experts.

The research focus of this thesis is to examine the risks and cost benefits of automating the training record for the Information Professional community, and to further discuss interface design issues and considerations for maximizing the flexibility and functionality provided by automation.

KEYWORDS: Training Record, Automation, Web-enabled, Information Technology
INFORMATION TECHNOLOGY MANAGEMENT

WIRELESS LOCAL NETWORK ARCHITECTURE FOR NAVAL MEDICAL TREATMENT
FACILITIES
Russell C. Deason, III-Lieutenant, United States Navy
B.S., Embry-Riddle Aeronautical University, 2000
Master of Science in Information Technology Management-September 2004
Advisor: Alexander Bordetsky, Department of Information Sciences
Second Reader: Glenn Cook, Department of Information Sciences

In today’s Navy Medicine, an approach towards wireless networks is coming into view. The idea of developing and deploying workable Wireless Local Area Networks (WLAN) throughout Naval hospitals is just a few years down the road. Currently, Naval Medical Treatment Facilities (MTF) are using wired Local Area Networks (LANs) throughout the infrastructure of each facility.

Civilian hospitals and other medical treatment facilities have been experimenting with the concept of WLAN for the past few years. The concept is not new within the Department of Defense. The potential use of wireless technology within a Naval MTF has been challenged by many different situations, which have hindered the opportunity to apply this technology earlier.

The use of wireless technology within a Naval MTF is boundless at this time. With newer capabilities being developed every few months or so, WLANs will eventually be a part of normal day to day operations for medical staff, administrators, and executives within Navy Medicine.

This thesis examines the architecture of an 802.11x WLAN within a Naval MTF from a “macro” view. Requirements and needs assessment are studied, along with the pros and cons of wireless that drive Navy Medicine towards the development and deployment of wireless 802.11x technologies. Second, this thesis reviews current technology, architecture, and policies that help in the decision-making process. Last, this thesis analyzes the cost benefits along with a developmental plan to help in determining if wireless is the way to go for Naval Medicine.

KEYWORDS: WLAN, 802.11, Wireless, Local Area Networks

AUTOMATED PSYCHOLOGICAL CATEGORIZATION VIA LINGUISTIC PROCESSING
SYSTEM
Mark D. Eramo-Captain, United States Marine Corps
B.S., University of Kansas, 1996
Master of Science in Information Technology Management-September 2004
Master of Science in Information Systems and Operations-September 2004
Christopher M. Sutter-Lieutenant, United States Navy
B.S., Hampden-Sydney College, 1996
Master of Science in Information Technology Management-September 2004
Master of Science in Information Systems and Operations-September 2004
Advisors: Raymond Buettner, Department of Information Sciences
Magdi N. Kamel, Department of Information Sciences

Influencing one’s adversary has always been an objective in warfare. To date, however, the majority of influence operations have been geared towards the masses or to very small numbers of individuals. Although marginally effective, this approach is inadequate with respect to larger numbers of high value targets and to specific subsets of the population. Limited human resources have prevented a more tailored approach, which would focus on segmentation, because individual targeting demands significant time from psychological analysts. This research examines whether or not Information Technology (IT) tools, specializing in text mining, are robust enough to automate the categorization/segmentation of individual profiles for the purpose of psychological operations (PSYOP). Research indicates that only a handful of software applications claim to provide adequate functionality to perform these tasks. Text mining via neural networks is determined to be the best approach given the constraints of the profile data and the desired output. Five software applications are tested and evaluated for their ability to reproduce the results of a social psychologist. Through statistical analysis, it is concluded that the tested applications are not currently mature enough to produce accurate results that would enable automated segmentation of individual profiles based on supervised linguistic processing.
INFORMATION TECHNOLOGY MANAGEMENT

EFFECTIVE USE OF COLLABORATIVE INFORMATION TECHNOLOGY TO ENHANCE GROUP PERFORMANCE
Patrick K. Gallaher-Major, United States Marine Corps
B.A., University of California, 1989
Master of Science in Information Technology Management-September 2004
Julie E. O’Rourke, Lieutenant Commander, United States Navy
B.A., Villanova University, 1989
Master of Science in Information Technology Management-March 2005
Advisor: Thomas J. Housel, Department of Information Sciences
Second Reader: Paul Pavlou, Anderson Graduate School of Management, University of California - Riverside

This research was inspired by the need to create a universal net-centric environment to enable collaborative defense capabilities and deliver knowledge dominance to the Department of Defense (DoD). Since superior information management and the use of collaborative information technologies is fundamental to building intelligence capabilities, this study aims to contribute to the optimization of collaborative system use by military groups and organizations.

The proposed research model illustrates and explains the direct relationships between collaborative information technology (CIT) competence and collaborative functionalities, which can be used to assess current technologies and aid in requirements generation for designing the ideal collaborative tool suite. Central to the research model is the concept of collaborative IT competence, defined as the effective use of collaborative functionalities. The relationship of this concept to performance outcomes is explored in this thesis.

Having pre-tested and validated the proposed research model by means of empirical data collection in the form of an end-user survey instrument, it is recommended that further research be conducted on a Navy-wide scale to evaluate the 181 collaborative technology tools currently in use. End-user/warfighter insight will dramatically influence future CIT investment decisions by providing decision-makers critical information regarding the pragmatic versus the advertised attributes of the application/tool suite. Additionally, this model is designed to provide the road map to the ideal combination of core functionalities and required collaborative IT competence.

KEYWORDS: E-mail Overload, Information Technology, IT, E-mail, Net-centric Environment, Collaboration, Collaborative Information Technology

MODELING AND ANALYZING INTRUSION ATTEMPTS TO A COMPUTER NETWORK OPERATING IN A DEFENSE-IN-DEPTH POSTURE
Mark A. Givens-Major, United States Marine Corps
B.S., Florida State University, 1991
M.S., Troy State University, 2000
Master of Science in Information Technology Management-September 2004
Advisors: Alexander Bordetsky, Department of Information Sciences
Joe Roth, Department of Information Sciences

In order to ensure the confidentiality, integrity, and availability of networked resources operating on the Global Information Grid, the Department of Defense has incorporated a “Defense-in-Depth” posture. This posture includes the use of network security mechanisms and does not rely on a single defense for protection. Firewalls, Intrusion Detection Systems (IDS’s), Anti-Virus (AV) software, and routers are examples of the tools used. In recent years, computer security discussion groups have included IDS’s as one of the most relevant issues. These systems help identify intruders that exploit vulnerabilities associated with operating systems, application software, and computing hardware. When IDS’s are utilized on a host

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computer or network, there are two primary approaches to detecting and/or preventing attacks. Traditional
IDS’s, like most AV software, rely on known “signatures” to detect attacks. This thesis focuses on the
secondary approach: Anomaly or “behavioral based” IDS’s look for abnormal patterns of activity on a
network to identify suspicious behavior.

**KEYWORDS:** Defense-in-depth, Global Information Grid, Intrusion Detection, Intrusion Detection

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**IEEE 802.16 TECHNOLOGIES AS A COMPLIMENT TO SHIP TO OBJECTIVE MANEUVER (STOM) COMMUNICATIONS**

Robert J. Guice-Captain, United States Marine Corps
B.S., University of Maryland, 1996
Master of Science in Information Technology Management-September 2004
Ramon J. Munoz-Captain, United States Marine Corps
B.S., Northeastern University, 1996
Master of Science in Information Technology Management-September 2004
Advisor: Rex Buddenberg, Department of Information Sciences
Second Reader: Dan C. Boger, Department of Information Sciences

This research evaluates the IEEE 802.16 standards and technologies that are currently being developed in
the commercial sector. The robust capability of this standard makes it useful to numerous military
applications. This research explores how this technology might address the shortcomings of existing
military radio and data systems; specifically with respect to the issues surrounding Ship to Objective
Maneuver (STOM) communications. The intent of this research is to provide recommendations on the
necessary “adapt from commercial-off-the-shelf (COTS)” changes needed for this technology to address
STOM networking requirements.

This research includes discussions on the military requirements for an IEEE 802.16 adapted waveform.
The requirements for the IEEE 802.16 “adapt from COTS” are derived from research on the Concept of
Employment for STOM operations and the specification of the Joint Tactical Radio Systems (JTRS)
Wideband Networking Waveform (WNW). These discussions offer an illustration of the complex
networking demands the COTS adapted systems would need to address. Through detailed exploration of
the current IEEE 802.16 standards and implementation testing with pre-standard IEEE 802.16a equipment,
authors make recommendations on the COTS adaptations necessary to make IEEE 802.16 suitable as a
complimentary technology within the STOM scenario.

**KEYWORDS:** 802.16, OFDM, STOM, OTM, NLOS, COTS, 802.11, MANET, MESH, JTRS, WNW,
Wideband Networking Waveform

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**A PROTOTYPE WEB-ENABLED INFORMATION MANAGEMENT AND DECISION SUPPORT
SYSTEM FOR ARMY AVIATION LOGISTICS MANAGEMENT**

Joseph A. Hoecherl-Major, United States Army
M.B.A., Embry-Riddle Aeronautical University, 1998
B.S., University of Central Florida, 1991
Master of Science in Information Technology Management-September 2004
Advisor: Magdi N. Kamel, Department of Information Sciences
Second Reader: Glenn Cook, Department of Information Sciences

The purpose of this thesis is to develop a prototype web-enabled database to improve the process flow of
data collection and manipulation in support of Army aviation operations. Data collection is focused around
routine aviation operations and aviation maintenance, with the intention of identifying a feasible
replacement for the existing redundant manual and automated collection procedures. The web interface has
the potential to reduce the logistical burden on a unit’s data collection procedures, and provides tailorable,
real time information about aircraft maintenance status, individual training, and unit training to
decision-makers at all levels. This thesis describes the design considerations for a web-enabled database,
including the development of detailed data and process models.
INFORMATION TECHNOLOGY MANAGEMENT


DEVELOP, BUILD, AND TEST A VIRTUAL LAB TO SUPPORT VULNERABILITY TRAINING SYSTEM
Coskun Kargin-First Lieutenant, Turkish Army
B.S., Turkish War College, 1998
Master of Science in Information Technology Management-September 2004
Turgut Akgul-First Lieutenant, Turkish Army
B.S., Turkish War College, 1999
Master of Science in Computer Science-September 2004
Advisor: Richard M. Harkins, Department of Physics
Second Reader: Wen Su, Department of Computer Science

A computer security virtual lab architecture is developed and tested for functionality and performance. Four Dell PowerEdge 1650, dual processor, blade servers are configured as host machines with VMware and VNC running on a Linux RedHat 9 Kernel. An Apache-Tomcat web server is configured as the external interface to lab users. Web content is created, the site is secured with Secure Socket Layers, and Java Servlet functionality is enabled. Host machine performance is tested under various load conditions. Analysis indicates that for this architecture, the average host machine CPU load was ~12 %, while the average memory load was ~33 %. It was concluded that for the cost and space requirements of 5 1U blade servers, an equivalent 20 computer lab was configured. Performance tests show that the virtual lab could scale easily from four to thirty computers.

KEYWORDS: Virtual Lab, Virtual Network, Virtual Machine, Web Server, Apache, Tomcat, VMware, VNC, SSL

USING COMMERCIAL AVIATION INFORMATION SYSTEMS IN OPERATIONAL SUPPORT AIRLIFT DECISION SUPPORT SYSTEMS
Charles P. Kubik, II-First Lieutenant, United States Air Force
B.S., United States Air Force Academy, 2002
Master of Science in Information Technology Management-September 2004
Master of Business Administration-September 2004
Advisors: Roxanne Zolin, Graduate School of Business and Public Policy
Glenn Cook, Department of Information Sciences

Air travel within the Department of Defense (DoD) could potentially be reinvented due to the disruptive technology of microjets. These smaller, more efficient aircraft will be able to provide cost effective point to point travel to their users. Along with this new way of travel comes the challenge of managing the customer requests, large networks of jets, personnel, and support activities. Decision Support Systems (DSS) can help manage these networks by attempting to create optimized scheduling solutions for the routing aircraft, crews, and logistical support needed to successfully operate in this new environment. The opportunity exists for the DoD’s private aircraft operation, the Joint Operational Support Airlift Center (JOSAC), to utilize some of the same system features used in commercial operations, such as NetJets, to improve operations.

This thesis analyzes the use of commercial air operator strategies and DSSs in JOSAC to improve operational effectiveness. It adds new capabilities and processes used in commercial DSSs, to the implementation of the disruptive technology, microjets. Some of the potential benefits include improved operational performance, solutions to scheduling inefficiencies, and improved mission readiness. With these improvements, the potential for a military microjet operation in the future is a real possibility.

KEYWORDS: JOSAC, JALIS, OSA, Microjet, Aviation, Decision Support System, NetJets, Intellijet II
Since the country has moved into the Information Age, military forces have been moving towards network based operations. The rapid expansion of the internet and information technology (IT) has led to the emerging theory of Network-Centric Warfare (NCW). The Naval services’ instantiation of NCW is FORCEnet. FORCEnet is the “glue” that binds together Sea Strike, Sea Shield, and Sea Basing. It is the operational construct and architectural framework for naval warfare in the Information Age, integrating warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force. FORCEnet will provide the architecture to substantially increase combat capabilities through aligned and integrated systems, functions, and missions.

Sea Power 21 is a comprehensive attempt to address the ramifications of the Information Age revolution. The framework of the Sea Power 21 vision is composed of the following elements: Sea Basing, Sea Shield, and Sea Strike. The enabler of this vision, or the “glue” that holds it all together, is FORCEnet. FORCEnet is “the operational construct and architectural framework of naval warfare in the information age that integrates Warriors, sensors, networks, command and control, platforms, and weapons into a networked, distributed combat force that is scaleable across all levels of conflict from seabed to space and sea to land.”

The Trident Warrior 03 (TW03) exercise was developed as a means to measure the success of FORCEnet and to acquire data against which future exercises could be measured. FORCEnet is still in its infancy and there are widely differing views on exactly what it is and how it should be implemented. The intent of this thesis is not to answer those questions per se, but to provide a realistic analysis of what did and did not work during the TW03 exercise. This analysis provides a baseline for further Trident Warrior exercises and may allow participants to avoid making same mistakes in the future. There is much work to be done before the military can fully realize a truly network-centric armed forces, but TW03 was the beginning and the lessons learned from the exercise will enable the military to obtain the goal of a fully networked system.

KEYWORDS: Network Centric Warfare, Information Warfare, FORCEnet, Trident Warrior, Joint Vision 2020, Sea Power 21

MICROSOFT WINDOWS SERVER 2003: SECURITY ENHANCEMENTS AND NEW FEATURES
Ronald C. Montehermoso-Lieutenant Commander, United States Navy
B.S., B.A., University of San Diego, 1993
Master of Science in Information Technology Management-September 2004
Advisor: Douglas E. Brinkley, Graduate School of Business and Public Policy
Second Reader: Glenn Cook, Department of Information Sciences

The purpose of this thesis is to discuss the new features and enhancements of Windows Server 2003. Windows NT and Windows 2000 were known to have numerous security vulnerabilities; hence, Microsoft focused on improving security by making Windows Server 2003 “secure by design, secure by default, secure in deployment.” This thesis examines the differences between the five unique editions of the Windows Server 2003 family. Some of the pros and cons of migrating to Windows Server 2003 are highlighted. The author intends this study to assist information technology professionals with their decision on whether or not to upgrade to this latest version of Microsoft’s flagship network operating system.

INFORMATION TECHNOLOGY MANAGEMENT

OPERATION AND MAINTENANCE SUPPORT INFORMATION (OMSI) CREATION, MANAGEMENT, AND REPURPOSING WITH XML
Scott P. Raymond-Lieutenant Commander, United States Navy
B.S., Rensselaer Polytechnic Institute, 1990
Master of Science in Information Technology Management-September 2004
Advisors: Daniel R. Dolk, Department of Information Sciences
Gordon H. Bradley, Department of Operations Research

In this thesis, an information integration problem was solved by developing an XML schema for representing Operation and Maintenance Support Information (OMSI) packages. The use of XML allows the OMSI authors to create information in a single format and repurpose the information to the needs of any maintenance organization. Repurposing requires just the low, one-time cost of creating transformation processes using XSLT, XQuery, or other XML transformation technology, after which each transformation can be done freely. In creating the XML schema, transformations necessary for integrating the OMSI deliverables directly into NAS Sigonella’s Computer-Aided Facility Management (CAFM) system are developed. This allows OMSI authors to immediately deliver new content at no cost, revolutionizing the way O&M requirements are planned and generated. A usable transformation process for Design-Based Planning Submittals is created. This process provides a no cost deliverable to NAS Sigonella to be used for gauging maintenance efforts on new facilities not yet delivered. Differences between data- and document-centric information and how each can best be represented using a single XML framework are examined and compared. The results of this thesis are ready for use at NAS Sigonella and other installations in the NAVFAC Atlantic Division’s Area of Responsibility. Results can also be applied throughout the DoN, DoD, or civilian sector to create a de jure standard for OMSI creation, management, and repurposing.

KEYWORDS: Information Integration, Operation and Maintenance, O&M, Support Information, OMSI, Building, Facility, Relational, XML, Data Models, Transformation, Repurposing, XSLT, XQuery

AIRBORNE UBIQUITOUS SURVEILLANCE AND MONITORING NETWORK
Axel Schumann-Kapitänleutnant, Federal German Navy
Electrical Engineer, Armed Forces University Munich, 1996
Master of Science in Systems Engineering-September 2004
Master of Science in Information Technology Management-September 2004
Advisor: Alexander Bordetsky, Department of Information Sciences
Second Reader: David Netzer, Center for Defense, Technology and Education for Military Services

This thesis examines the emergence of wireless technology as a pragmatic baseline supporting the goals of the Department of Defense in the development of Network Centric Forces. Increased international attention to the field of surveillance has developed in conjunction with the desire to interconnect all possible friendly forces in military operations and the Global War on Terror (GWOT).

Ubiquitous surveillance is accomplished by prototyping a network node that is then integrated onboard a military-type unmanned aerial vehicle (UAV).

Although the commercial-off-the-shelf network solution itself is broadly deployed, little is known so far regarding the operation and management of an airborne surveillance network node. The author shows that the use of unmanned aerial vehicles for networking purposes is not only possible, but manageable, even with remote operation of the unmanned aerial vehicle. The documented experiments, conducted over three generations of prototypes, provide insight about how network infrastructure independence for the purpose of surveillance can be reached.

KEYWORDS: Surveillance, Airborne, Network, Wireless, 802.11, Unmanned Aerial Vehicle, UAV, Network Operations
MORAL DEVELOPMENT AT THE UNITED STATES NAVAL ACADEMY: THE MIDSHIPMAN’S PERSPECTIVE
Timothy M. Clark-Lieutenant, United States Navy
B.S., United States Naval Academy, 1998
Master of Science in Leadership and Human Resource Development-September 2004
Advisors: Albert C. Pierce, United States Naval Academy
CAPT Dana P. French, Jr., USN (Ret.), United States Naval Academy

This study examines midshipmen perceptions of moral development at the Naval Academy. Six focus groups, comprising a total of 45 first-class midshipmen, are conducted to discover aspects of the Naval Academy experience that have positive, neutral, and negative impacts on midshipmen’s moral development. Focus group midshipmen report that good personal examples, open-forum discussions of ethical case studies, assuming midshipmen leadership responsibilities, and participation in sports have a positive impact on their moral development. Parts of the Naval Academy experience that had a neutral impact on their moral development included some aspects of the core ethics course, the behavior of some of their peers, and the “directed development” approach they perceived in many of the Academy programs. Focus group midshipmen also believe that there are too many ethics and character programs, and that they are too repetitious and too routine to have more than a neutral impact on their moral development. Finally, focus group midshipmen cited bad example by some officers, the Bancroft Hall culture, and weaknesses in the Honor System as having a negative impact on their moral development. This study concludes with several recommendations from the midshipmen and the author to improve moral development efforts at the Naval Academy.

KEYWORDS: Ethics, United States Naval Academy, Honor, Moral Development, Role Models

AN ANALYSIS OF THE EFFECT OF QUANTITATIVE AND QUALITATIVE ADMISSIONS FACTORS IN DETERMINING STUDENT PERFORMANCE AT THE U.S. NAVAL ACADEMY
Barton L. Phillips-Lieutenant, United States Navy
B.S., United States Naval Academy, 1996
Master of Science in Leadership and Human Resource Development-September 2004
Advisors: Stephen L. Mehay, Graduate School of Business and Public Policy
William R. Bowman, United States Naval Academy

This thesis analyzes the effect of quantitative and qualitative factors used in the admissions process at the Naval Academy in determining student performance of candidates admitted. In determining student performance, graduation, Order of Merit, cumulative academic QPR, cumulative military QPR, and stripper selection are used as performance outcome measures. The data is from Naval Academy graduation year groups 1995 through 2001. The analysis separates the Naval Academy’s Whole Person Multiple into quantitative and qualitative inputs. The Candidate Multiple (CM) is the quantitative input to the admissions process, derived from a statistical based scoring model anchored in proven high school performance measures, such as SAT and high school GPA. The Recommendations of the Admissions Board (RAB) is the qualitative input, awarding points for subjective traits not captured in the CM or from various other subjective measures, such as student interviews and essays. This research highlights the properties of the two admissions factors and the estimated impact on student performance. The results show that student performance increased as CM and RAB increased, revealing the importance of a combined quantitative and qualitative admissions process, and emphasizing the qualitative input as the value added to the admissions process providing the increased predictability of student success.
LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

KEYWORDS: U.S. Naval Academy, Admissions, Whole Person Multiple, Candidate Multiple, Recommendations of the Admissions Board, SAT, Student Performance
Friction Stir Processing (FSP), although relatively simple in concept, results in an extremely complex thermomechanical treatment to the material being processed. Previous studies of FSP have shown that the process results in extremely high strain, strain rates, and temperatures as well as gradients in strain, strain rate and temperature within a small volume of material. This thesis studies the effect of varying FSP parameters during the processing of Nickel-Aluminum-Bronze (NAB) propeller material. The modeling program CTH is used to define the relationship between tool rotation speed, traversing speed, and the total power input to the material. The tool’s mechanical power and the power generated by deformation of the material is investigated. The modeling experiments are designed to gain an understanding of the relationship of process parameters, microstructure, and mechanical properties, and to enhance understanding of the flow patterns and thermal histories of the NAB material in the stir zone.

KEYWORDS: Friction Stir, Modeling, Simulation, Thermal Power, Heat Input, Welding, NiAl Bronze

A single-stage transonic research compressor and test rig are used to obtain data on the effect of inlet flow distortion on compressor (and therefore engine) stall. Auxiliary injection was examined as a technique for generating distortion in inlet stagnation pressure, or temperature, or to simulate the more complex effects of engine steam ingestion from a catapult launch. Engineering analyses are developed and programmed in Engineering Equation Solver (EES) software to relate inlet conditions to the compressor characteristics, for both pressure and temperature distortion. An injection duct area of 8% is selected to limit the required heater power. A computational fluid dynamic (CFD) analysis is carried out to predict the compressor inlet flow field and hence position the injection duct exit. It is found that a broad range of distortion parameters could be generated by simply ducting (and heating) atmospheric air (or steam) through an auxiliary inlet throttle valve.

KEYWORDS: Compressor, Distortion Generation, Turbomachinery
Large shear stresses often develop at the interface between dissimilar materials in microelectronic devices when they are subjected to thermo-mechanical excursions. These stresses can facilitate diffusionally accommodated interfacial sliding, or creep. A driving factor for these stresses is the thermal expansion mismatch between the adjoining materials. For narrow thin film lines, these stresses may exist over a large fraction of the film-substrate interface. This thesis explores methodologies to measure the kinetics of interfacial creep at model Al thin film/silicon substrate interfaces. A method of sample production, which involved diffusion bonding a polished Si substrate to the surface of a thin Al film deposited on a second Si substrate, was developed (Si/Al/Si sandwich). When loaded edge-wise in compression, the Al thin film - Si interface are loaded in shear.

By measuring the relative displacements between the two Si substrates, the interfacial displacement rates at varying temperatures and stresses are experimentally determined. In accordance with previous results, the kinetics are given by a diffusional creep law with a threshold stress, and an activation energy representing interfacial diffusion. The activation energy is found to be unusually low, and further experimental and modeling studies are needed to better understand its origin.

**KEYWORDS:** Interfacial Sliding, Diffusional Sliding, Interfacial Creep, TMAH, PVD Al Thin Film, Diffusion Bonding

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Friction Stir Processing (FSP) is a novel technique for localized modification of the surface layer of materials. FSP produces high local strains, strain rates, and local temperatures that are 0.8 - 0.9 Tm, where Tm is the melting point. The processing enhances the microstructural and mechanical properties of materials through intense plastic deformation. This thesis examines the microstructure and tensile properties in FSP'ed Nickel Aluminum Propeller Bronze (NAB) as a function of position in the stir zone using a unique miniature tensile sample design. Test materials are single and multi-pass FSP runs from both 6 mm and 13 mm tools. Tensile ductility is observed to increase from 11 percent to more than 30 percent elongation to fracture at locations along the center of the stir zone. Yield and ultimate strengths also increase two-fold. These improved properties are associated with the formation of Widmanstätten $\alpha$ and fine, equiaxed $\alpha$ at peak temperatures of approximately 1000°C in these locations. Some locations in the heat affected zone (HAZ) or thermomechanically affected zone (TMAZ) exhibit ductilities below that of as-cast material. Such regions had microstructures that contained a dark-etching constituent formed by cooling after being heated to approximately 800°C.

**KEYWORDS:** Friction Stir Processing, Ni Al Bronze, Microstructure, Mechanical Properties
LANGMUIR CIRCULATIONS IN A COASTAL ENVIRONMENT DURING CBLAST
Murat Elge-Lieutenant Junior Grade, Turkish Navy
B.E., Turkish Naval Academy, 1998
Master of Science in Meteorology and Physical Oceanography-September 2004
Advisor: Timothy P. Stanton, Department of Oceanography
Second Reader: Edward B. Thornton, Department of Oceanography

Langmuir circulations in a coastal environment at an inner shelf site with strong tidal forcing are examined using a 4-month observation of high-resolution velocity profiles during the Office of Naval Research-sponsored Coupled Boundary Layers Air Sea Transfer (CBLAST)-Low air-sea interaction experiment. Because of their potential contributions to mixing processes in the surface boundary layer, Langmuir circulations are important for naval operations such as anti-submarine warfare (ASW), mine counter measures (MCM), and Amphibious operations in littoral waters. A detection algorithm for upwelling/downwelling velocities due to Langmuir circulations is developed. Analyses focus on long-fetch, unstratified water column conditions with locally developed seas. The observations show that strong Langmuir circulations greatly reduce water column shear arising from the tidally forced bottom boundary layer, while there is no significant effect from the strong tidal boundary layer on the formation of Langmuir cells. Long fetch conditions have the strongest vertical velocities with a Langmuir number of 0.1-0.4, while short fetch conditions have weaker vertical velocities with a Langmuir number greater than 0.5. Cell vertical velocities are correlated with the water friction velocity, but penetration depths do not depend on forcing mechanisms. Spacing and penetration depths are correlated for increasing wind speed and wave heights, whereas this correlation is not seen for constant high wind speed and wave heights.

KEYWORDS: Langmuir Circulations, Coastal Environment, Mixing Processes in Upper Ocean, Turbulence Flow, Tidal Current

ANALYSIS OF LATERAL BOUNDARY EFFECTS ON INNER DOMAIN OF COAMPS
Brad G. Harris-Lieutenant, United States Navy
B.S., Oregon State University, 1995
Master of Science in Meteorology and Physical Oceanography-September 2004
Master of Science in Applied Mathematics-September 2004
Advisors: Douglas K. Miller, Department of Meteorology
Beny Neta, Department of Applied Mathematics

One of the major problems with a Limited Area Model (LAM) is the introduction of error from the lateral boundaries. The boundary condition provides a source of forcing to the interior of the model. This forcing typically originates from a global model such as the Navy Operational Atmospheric Prediction System (NOGAPS). The transition at the boundary from one model to another invariably produces errors. Traditionally, the way to minimize boundary error is to move the boundary as far away from the area of interest as possible. In this way, the errors do not have time to infest the LAM with “bad” information. Moving the boundary far away from the area of interest increases the computational forecast load and decreases its timeliness. This study looks at how close the lateral boundary can be to minimize computational time and still maintain a forecast that is useful. It is found that when the entire inner COAMPS nest is analyzed, the differences between the control forecast and the test forecast are within the natural variability of the control grid. It is also found that there are localized areas within the model domain that differ between the control domain and the test domain by up to 20 mb for the sea level pressure after a six day forecast.
AN ASSESSMENT OF NOGAPS PERFORMANCE IN POLAR FORECASTING FROM SHEBA DATA

Aaron D. Lana-Lieutenant, United States Navy
B.S., University of Washington, 1998
Master of Science in Meteorology and Oceanography-September 2004
Advisor: Peter Guest, Department of Meteorology
Second Reader: Douglas K. Miller, University of North Carolina-Asheville

This study evaluates the latest Navy Operational Global Atmospheric Prediction System (NOGAPS) version 4.0 by comparing data collected during the Surface Heat Budget of the Arctic (SHEBA) project from October 1997 to October 1998. Three periods from this year long study are the focus of this thesis, including a winter, spring, and summer case. For each of these cases, the first 24-hour period of the forecasts are analyzed for any bias and root mean square difference from the SHEBA data. NOGAPS had no significant biases in pressure and wind speed. During the winter case, the NOGAPS surface temperature remained near -28°C while observed temperature varied in response to cloud cover changes and was lower by an average of 5.3°C. During the spring, the NOGAPS temperatures had a steady increase from -11°C until reaching the melt season temperature of 0°C 11 days earlier than observed. As a result of too warm a surface and less downwelling longwave radiation, the net longwave flux cooling was greater than observed, by an average of -12.4 Wm⁻². The NOGAPS net shortwave radiation was greater than observed by an average of 62 Wm⁻² for spring and 22.6 Wm⁻² for summer.

SENSITIVITY OF SATELLITE ALTIMETRY DATA ASSIMILATION ON A NAVAL ANTI-SUBMARINE WARFARE WEAPON SYSTEM

Steven Mancini-Lieutenant Commander, United States Navy
B.S., Xavier University, 1992
Master of Science in Meteorology and Physical Oceanography-September 2004
Advisor: Peter C. Chu, Department of Oceanography
Second Readers: Charlie N. Barron, Naval Research Laboratory, Stennis Space Center
Eric L. Gottshall, National Oceanic and Atmospheric Administration

The purpose of this thesis is to assess the benefit of assimilating satellite altimeter data into the Modular Ocean Data Assimilation System (MODAS). To accomplish this, two different MODAS fields are used by the Weapon Acoustic Preset Program (WAPP) to determine suggested presets for a Mk 48 variant torpedo. The MODAS fields differ in that one uses altimeter data assimilated from three satellites, while the other uses no altimeter data. The metric used to compare the two sets of outputs is the relative difference in acoustic coverage area generated by WAPP. Output presets are created for five different scenarios, two Anti-Surface Warfare scenarios and three Anti-Submarine Warfare scenarios, in each of three regions: the East China Sea, the Sea of Japan, and an area south of Japan that includes the Kuroshio current. Analysis of the output reveals that, in some situations, WAPP output is very sensitive to the inclusion of the altimeter data because of the resulting differences in the subsurface predictions. Analysis suggests that the change in weapon presets could be significant enough to degrade the effectiveness of the weapon.

KEYWORDS: Satellite Altimetry, MODAS, Anti-submarine Warfare, ASW, MK-48 Torpedo, WAPP, USW
Presently, ice extent forecast models, such as the U.S. Navy Polar Ice Prediction System (PIPS), neglect or treat small-scale thermodynamic processes and entrainment unrealistically. Incorporating better algorithms that include more complete physics of the mixed layer dynamics will allow for improved prediction of ice thickness and distribution, open water boundaries, polynyas, and deep-water formation in the polar seas.

A one-dimensional, mixed layer, turbulent kinetic energy (TKE) budget model based on Garwood’s NPS mixed layer model for deep convection (Garwood, 1991) is written in MATLAB. The model consists of a system of ten equations derived by vertically integrating the budgets for heat, momentum, salinity, and turbulent kinetic energy between the sea-ice-air interface and the base of the turbulent mixed layer.

The NPS mixed layer model is tested using atmospheric forcing and ocean profiles collected at the Surface Heat Budget of the Arctic Ocean Experiment (SHEBA) site. Sensitivity studies using ocean profiles of the Greenland Sea are also conducted to address thermodynamics and ocean profiles that enhance thermohaline circulation. Findings and results are presented. Recommendations are made for further study to extend the relationships determined from small 1-D scales to the larger 3-D scales suitable for improvements to current ice models.

**KEYWORDS:** Mixed Layer, SHEBA, Greenland Sea, Thermobaricity, Entrainment, Air, Sea, Ice, Interaction, Modeling, Arctic Ocean

To achieve integration of the Naval Meteorology and Oceanography (METOC) community into the developing FORCEnet environment, transformational innovations must be researched and implemented. Agent-based software is an example of technology that can be employed in this way by changing the method by which METOC data is distributed to end-users. This thesis documents the creation and implementation of a software agent that uses Internet connections to retrieve numerical model data, loads this output into array data containers, and then makes it available to the end-user in a machine-readable forecast object format. The impact of the importation of this forecast object into warfare commander command-and-control software is then assessed using the commercially available SEAWAY logistics tool. This assessment highlights the importance of defining the METOC functional requirements for the emerging FORCEnet environment, so that proper interfaces to exchange data freely, and visually depict that data, are incorporated during next generation software development. Using these types of agents to automate the generation and delivery of weather parameters could also allow the importation of data into previously insular software, provide reach-back support to the warfighter, and be a means of reducing manpower and budgetary requirements during this time of fiscal constraint.

**KEYWORDS:** METOC, Transformation, FORCEnet, Software Agents, SEAWAY
A REAL-TIME ROPE MODEL SUITABLE FOR GAME ENGINE USAGE

Randy A. Garrido-Major, United States Army
B.A., University of Guam, 1992

Master of Science in Modeling, Virtual Environments and Simulation-September 2004
Advisor: Michael J. Zyda, Modeling, Virtual Environments and Simulation Institute
Second Reader: CDR Joseph A. Sullivan, USN, Modeling, Virtual Environments and Simulation Institute

This thesis attempts to lay a foundation for producing a real-time rope model suitable for game engine usage. The model presented here is one of the many possible approaches in modeling a rope. The basic premise used was derived from Erkin Tunca’s source code. The concept is then applied on the Open Dynamics Engine (ODE) built by Russell Smith.

This work shows promise but much additional work is needed on this subject. ODE is primarily designed for (articulated) rigid bodies, and so the next step is to create a deformable body (the rope) in ODE.

KEYWORDS: Rope Model, Rope, Simulation, Virtual Environment, Mass-Spring Method

DESIGNING A COMMON INTERCHANGE FORMAT FOR UNIT DATA USING THE COMMAND AND CONTROL INFORMATION EXCHANGE DATA MODEL (C2IEDM) AND XSLT

Glenn A. Hodges-Major, United States Army
B.S., Old Dominion University, 1993

Master of Science in Modeling, Virtual Environments and Simulation-September 2004
Advisors: Curtis Blais, Modeling, Virtual Environments and Simulation Institute
Donald P. Brutzman, Modeling, Virtual Environments and Simulation Institute

A common problem between military applications and operators is the consistent and meaningful exchange of data. Currently, several models and simulations exist for the purposes of training and analyzing military data. Due to the absence of an agreed-upon standard with which to represent unit data, much is lost during interchange and applications are not maximized. This thesis is a step towards a solution.

Extensible Markup Language (XML) technology has been widely accepted as a standard for representing information in such a way that it is self-documenting, self-validating, and platform independent. By using the Command and Control Information Exchange Data Model (C2IEDM), formerly known as Generic Hub, and XML, it is possible to develop a representation of unit data that is extensible and broadly useable by tactical systems and human operators alike. This thesis approaches the problem of exploring the Model Driven Architecture (MDA) and the Extensible Modeling Simulation Framework (XMSF) as possible overarching architectural concepts for a global solution.

The C2IEDM is used as the core data interchange model for this research and applies XML technologies, schema, and the Extensible Stylesheet Language for Transformations (XSLT) to derive a formatted data representation that is acceptable within the Flexible Asymmetric Simulation Technologies (FAST) Toolbox. The transformation example serves as a template for other simulation programs to follow for interchange through the common base model.

This thesis shows that by using a common data representation like C2IEDM, coupled with the power of XML and XSLT, unit information can be transformed and interchanged between applications. In order to accomplish this, an extensive analysis is conducted on recently performed and ongoing research, as well as the development of an exemplar to show how the proposed process is completed. The result of this work is
a transformation of unit data extracted from an example C2IEDM instance file that is compliant with the schema for an actual unit order of battle tool used for modeling and simulation.

**KEYWORDS:** Extensible Markup Language, XML, Extensible Markup Language for Transformations, XSLT, C2IEDM, Model Driven Architecture, MDA, ATCCIS, MIP, UOB, FAST, BML, XMSF

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**A LINEAR PHYSIOLOGICAL VISUAL-VESTIBULAR INTERACTION MODEL FOR THE PREDICTION OF MOTION SICKNESS INCIDENCE**

Panayiotis G. Matsangas-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1992
Master of Science in Operations Research-September 2004
Master of Science in Modeling, Virtual Environments, and Simulation-September 2004
Advisors: Michael E. McCauley, Department of Operations Research
Nita Lewis Miller, Department of Operations Research
Second Reader: Alan R. Washburn, Department of Operations Research

This thesis proposes an etiologic linear model based on human physiology for the explanation of the Motion Sickness Incidence (MSI) found in McCauley, et al. experiments (1974, 1976). The model is based on known theories (sensory conflict, observer theory), physiological processes, and existing models dealing with spatial orientation and motion sickness. It takes into account the basic concepts of time accumulation attribute of motion sickness, the “neural store,” and the addition of vestibulo-ocular reflexes (VOR) and optokinetic nystagmus (OKN) hypothesis. The vestibular and visual human sensory systems and their interactions are studied. The combined error produced in the aforementioned sensory systems used to estimate the Motion Sickness Incidence derives from the normalized error in the estimation of gravity vector in the vestibular system; and the error produced in the visual system due to retinal slip (residual optical flow), because of imperfect compensation from the vestibulo-ocular and optokinetic reflexes. The predicted maxima are at 0.196 [Hz] for gravity estimation error and 0.167 [Hz] for visual error; thus peak MSI lies within this frequency region. The proposed model predicts MSI for two-hour exposure with less than ±5% error, compared to the previous descriptive model and to corresponding experimental data, in the frequency range between 0.07 [Hz] and 0.25 [Hz]. The difference between the proposed model and the human factors research (HFR) experiments is increased at the outer frequency regions of the data. Furthermore, the time prediction of MSI and the corresponding adaptation process are approximated with adequate precision by the proposed model. The difference in predicted MSI between the proposed and the HFR experiments is attributed to the vertical-axis constraint and the lack of proprioception.

**KEYWORDS:** Human Performance, Motion Sickness, Human Physiology, Human Physiology Modeling

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**SYNTHETIC VISION: VISUAL PERCEPTION FOR COMPUTER GENERATED FORCES USING THE PROGRAMMABLE GRAPHICS PIPELINE**

Eugene Ray Pursel-Captain, United States Marine Corps
B.S., Pennsylvania State University, 1995
Master of Science in Modeling, Virtual Environments, and Simulation-September 2004
Advisor: Christopher J. Darken, Department of Computer Science
Second Reader: CDR Joseph A. Sullivan, USN, Department of Computer Science

In visual simulations, the human must make most decisions based on the visual cues rendered to a display. On the other hand, synthetic forces have the luxury of basing their decisions on the data contained in the simulation’s model. Line of sight calculations are often examples of the synthetic player’s excess of information. Current methodologies for determining a synthetic player’s line of sight to a target are generally variations of a ray-casting technique. With this technique, players are unable to hide from a synthetic player by being shadowed, camouflaged, or simply motionless. There is no “hiding in plain sight.” Synthetic vision is an alternative to ray-casting. Multiple renders from each synthetic player’s point of view are performed and those images are temporarily maintained in graphics memory. Vertex and fragment shader programs are then executed to make comparisons of the stored images. All the renders and calculations are performed on the Graphics Processing Unit (GPU) and the result is returned to the
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synthetic player in the form of an annotated list of visible targets. Performing the target visibility calculations on the GPU gives the synthetic player a more robust spectrum of visual inputs with which to make decisions.

KEYWORDS: Line of Sight, Target Detection, Pixel Buffer, Render To Texture, Fragment Program, OpenGL Shading Language, Artificial Intelligence, Synthetic Player, Programmable GPU, General Purpose Computation Using GPU

WARGAMING AND SIMULATION AS TOOLS FOR CONOPS DEVELOPMENT
Russell A. Rhoads-Major, United States Army
B.S., University of Kansas, 1991
Master of Science in Modeling, Virtual Environments, and Simulation—September 2004
Scott D. Gilman-Captain, United States Army
B.S., United States Military Academy, 1995
Master of Science in Modeling, Virtual Environments, and Simulation—September 2004
Advisors: LTC Saverio M. Manago, USA, Department of Operations Research
Thomas W. Lucas, Department of Operations Research

The purpose of this thesis is to use wargaming and simulation to gain insight into the effective employment of a new Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) system, the Adaptive Joint C4ISR Node (AJCN). The AJCN provides the supported commander with several capabilities, including range extension, waveform bridging, signal intelligence, electronic warfare and information operations. Two methods are used to gain insight into the support generation of the concept of operations for the AJCN's employment. The first method is wargaming. The wargaming method utilized a class of Naval Postgraduate School (NPS) students and the Joint Conflict and Tactical Simulation (JCATS) combat simulation model. The wargaming generated insights concerning the AJCN's employment. The second method is the use of a constructive simulation model, Point of Attack (POA) 2. Insights gained from the two methods include: the need for commanders to differentiate the AJCN and its supporting platform; the need for effective information processing techniques; and the importance of maintaining at least two-tiers of AJCN coverage to enhance situational awareness of the supported units.

KEYWORDS: AJCN, Wargaming, JCATS, POA 2, C4ISR, CONOPS, Unmanned Aerial Vehicles

TACTICAL WEB SERVICES: USING XML AND JAVA WEB SERVICES TO CONDUCT REAL-TIME NET-CENTRIC SONAR VISUALIZATION
Scott A. Rosetti-Lieutenant, United States Navy
B.A., University of Notre Dame, 1998
Master of Science in Modeling, Virtual Environments, and Simulation—September 2004
Advisor: Donald P. Brutzman, Modeling, Virtual Environments and Simulation Institute

With the unveiling of ForceNet, the Navy’s architectural framework for how naval warfare is to be conducted in the information age, much of the technological focus has been placed on Web technology. One of the most promising technologies is Web services. Web services provide for a standard way to move and share data more reliably, securely, and quickly. The capabilities imbedded in Extensible Markup Language (XML) and Simple Object Access Protocol (SOAP) can merge previously disparate systems into one integrated environment. Already proven successful in the administrative realm, wide-area networks such as the Secure Internet Protocol Network (SIPRNET) have become secure and reliable enough to pass data between systems and units to support tactical operations. The Modeling, Virtual Environments and Simulation (MOVES) Institute at the Naval Postgraduate School is currently working to extend these precepts into the modeling and simulation world under the Extensible Modeling and Simulation Framework (XMSF) project. By leveraging Web service technology, warfighters at the “tip of the spear” can have access to previously unrealized amounts of tactically-relevant data, analysis, and planning tools.

The goal of this thesis is to apply the XMSF and Extensible 3D (X3D) graphics to the field of sonar visualization. Undersea warfare is a complex operation that requires a continuous and detailed analysis of the acoustic environment. Tactical sensor employment without a firm understanding of the complete
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undersea picture can have fatal consequences. The Navy has spent significant resources to develop training systems and tactical decision aids in an effort to integrate training, rehearsal, and execution. Unfortunately, many of the high-resolution analysis tools that provide high-resolution sonar prediction results are not easily accessible to the fleet. By taking advantage of Web services and XMSF technology, warfighters will need only access to the network to be able to pull real-time environmental analysis data from large databases, remotely run sonar prediction models on supercomputers, and view detailed three-dimensional (3D) virtual worlds that visualize the undersea picture.


SIMULATING CLOUDS WITH PROCEDURAL TEXTURING TECHNIQUES USING THE GPU
Georgios E. Tarantilis-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1993
Master of Science in Modeling, Virtual Environments and Simulation-September 2004
Advisors: Rudolph P. Darken, Modeling, Virtual Environments and Simulation Institute
CDR Joseph A. Sullivan, USN, Department of Computer Science
Second Reader: Erik Johnson, Department of Computer Science

Many 3D training simulations employ static, and to some extent, simplistic natural phenomena representation that often leaves much to be desired. Taking advantage of the latest advancements in computer graphics hardware allows for the modeling of dynamic natural phenomena such as clouds. Specifically, by utilizing procedural techniques and high-level shading languages, it is possible to produce considerably more realistic simulations. This thesis designs and implements a visual simulation component that renders convincing clouds, using procedural noise-based texture mapping techniques. Both traditional rendering and shader-enabled rendering supported by the OpenGL Shading Language are utilized. This component is included in the Delta3d simulation engine and is used to create convincing clouds in outdoor simulations while the performance penalty imposed is considered acceptable. Custom tools are developed for easy noise texture parameterization, and cross-platform compatibility is demonstrated.

KEYWORDS: Linux3D Training Simulations, Clouds, Convincing Clouds, Rendering, Shader-enable Rendering, OpenGL Shading Language, Delta3d Simulation Engine, Texture Parameterization, Cross-platform Compatibility

A TRAINING TRANSFER STUDY OF THE INDOOR SIMULATED MARKSMANSHIP TRAINER
William W. Yates-Major, United States Marine Corps
B.S., Texas A&M University, 1990
Master of Science in Modeling, Virtual Environments and Simulation-September 2004
Advisor: Rudolph P. Darken, Modeling, Virtual Environments and Simulation Institute
Second Reader: Simon Goerger, United States Military Academy

This thesis examines the effectiveness of the Indoor Simulated Marksmanship Trainer (ISMT) as a tool to train shooters in the fundamentals of marksmanship. Key concepts explored in the research are verification of skills transfer resulting from practice and the predictive value of simulated performance to proficiency at real task performance. There is no statistical difference found between the scores of recruits trained in the ISMT and a control group that was not trained in the ISMT. Scores on simulated firing are not a strong predictor of live fire performance. In a second experiment, subjects are evaluated on their proficiency and improvement (during un-coached practice) at the task of simulated precision fire on a target at a simulated known distance of 300 yards from the shooters. After comparable amounts of practice in the ISMT, subjects who had not previously received formal marksmanship training fail to demonstrate levels of proficiency comparable to those subjects who had previously received formal marksmanship training in the military. Consequently, the research finds no evidence to suggest the ISMT qualifies as a black box.
training apparatus capable of imparting skill through practice without the added presence of expert instruction or an existing knowledge of marksmanship techniques.

**KEYWORDS:** ISMT, Marksmanship, Skills Acquisition, Training Transfer, Virtual Environment Trainer
MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

THE RELATIONSHIP BETWEEN SLEEP REGIMEN AND PERFORMANCE IN UNITED STATES NAVY RECRUITS
Charles H. Andrews, III-Lieutenant Commander, United States Navy
B.S., University of Mississippi, 1992
Master of Science in Operations Research-September 2004
Advisor: Nita Lewis Miller, Department of Operations Research
Second Reader: Thomas W. Lucas, Department of Operations Research

Fatigue due to sleep deprivation is a major factor in both mental and physical performance. Failure of recruits to receive the proper quality and quantity of sleep can be detrimental to a recruit’s safety and can diminish the amount of information learned during training. During the 1980s, the sleep regimen was decreased to six hours of sleep per night. In 2002, a decision was made to give U.S. Navy recruits an additional two hours of sleep per night. This modification was selected to coincide with the acknowledged adolescent/young adult circadian rhythms.

The purpose of this study is to determine the impact of the new eight-hour sleep regimen using standardized test scores as a performance measure. One year of data with the eight-hour sleep regimen is compared to two separate years when only six hours of sleep was allowed.

There is a significant difference, \( F(2, 33) = 29.82, \ p < .0001 \), between the test scores of recruits receiving six hours of sleep and eight hours of sleep. On average, test scores rose by 11 percent with the additional sleep. The odds of observing such a difference is less than one in ten million.

KEYWORDS: Fatigue, Recruit Training Center, Sleep and Learning, Test Scores, U.S. Navy Recruits, Military Recruit, Boot Camp

ANALYSIS OF THE VERTICAL TAKEOFF AND LANDING UNMANNED AERIAL VEHICLE (VTUAV) IN SMALL UNIT URBAN OPERATIONS
Roman K. Cason-Captain, United States Marine Corps
B.S., Louisiana State University, 1994
Master of Science in Operations Research-September 2004
Advisor: Susan M. Sanchez, Department of Operations Research
Second Reader: Paul J. Sanchez, Department of Operations Research

The Marine Corps has recently embarked on the development of a Vertical Takeoff and Landing Unmanned Aerial Vehicle (VTUAV) to replace the aging Pioneer system. This thesis examines the critical elements this platform must possess in order to effectively support small units operating in urban environments. This issue is addressed by creating and exploring an agent-based simulation of a platoon conducting an urban patrol in a setting similar to those currently encountered in Iraq. The platoon utilizes the VTUAV as an intelligence-gathering asset.

An efficiently designed experiment is used to generate data from the simulation scenario, and then multiple regression and regression trees are used to relate the UAV capabilities to the patrol’s operational effectiveness. Results suggest that the effectiveness of a VTUAV is greatly influenced by noise in the urban warfare environment. A loss function is used, along with the regression models, to identify UAV configurations that improve operational effectiveness, yet provide robust response to uncertainties about civilian and insurgent behavior. The VTUAV must have high communication capability, as well as accurate sensing, in order to perform well across a range of environmental conditions.

Each year the United States Marine Corps suffers excessive loss of man-years from Marines awaiting entry-level schools. During fiscal year 2001 (the most recent complete time-awaiting-training data), Marines exceeded 2,800 man-years of time awaiting training. Non-infantry personnel comprise 80% of the more than 30,000 recruits shipped to Marine Corps Recruit Depots each year, but they constitute almost 95% of the 2,800 man-year loss. Marine Corps manpower planners consider the current level of loss unacceptable and believe significant improvement can be gained by optimally scheduling courses at Military Occupational Specialty (MOS) schools. This thesis uses an integer linear program, Entry-Level Course Scheduler (ELCS), to optimize a course schedule that includes recommended seat assignments by MOS and gender. ELCS seeks to minimize the time-awaiting-training while successfully meeting yearly classification requirements. ELCS results using fiscal year 2003 data indicate time-awaiting-training can be reduced to only 1,700 man-years (a 1,100 man-year improvement, when compared with fiscal year 2001 data).

**KEYWORDS:** Integer Linear Program, Scheduling, MOS Training, Optimization, Assignment, Manpower, Personnel, Training

The purpose of this thesis is to analyze data related to sleep patterns of warfighters deployed to the Southwest Asia (SWA) Area of Operation. To this end, subjective survey data was collected from warfighters operating in Iraq and Kuwait from 25 August-15 October 2003 (n=273). Participants were asked about unit-level sleep planning, sleep/wake patterns, and lifestyle factors. Using the survey results, insight is gained regarding four primary research questions. First, is sleep deprivation a significant problem for forces in the SWA region? Second, do current sleep logistics support a unit’s ability to accomplish assigned missions? Third, are there differences in sleep patterns between subset populations? And last, does the current survey method support the research objectives? To address these questions, analysis techniques such as principal components analysis, factor analysis, and parametric and nonparametric hypothesis testing are used. The reliability of the subjective survey results is tested by comparing self-reported survey data with actigraphy data corresponding to the same time period (n=34 paired observations). This thesis also provides insight regarding the use of sleep logistics as a force multiplier during continuous/sustained operations by discussing known fatigue countermeasures and their role in improving individual and unit performance effectiveness.

**KEYWORDS:** Sleep Logistics, Sleep Logistics Survey, Fatigue, Fatigue Countermeasures, Sleep, Sleep Loss, Sleep Deprivation, Performance, Military, Warfighters, Continuous Operations, CONOPS, Sustained Operations, SUSOPS, Principal Components Analysis, Factor Analysis, Categorical Data Analysis, Statistical Analysis
ANALYSIS OF THE INFLUENCE OF TURBULENCE AND ENVIRONMENTAL VARIABILITY ON BROADBAND ACOUSTIC COHERENCE
Ozer Eroglu-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1998
Master of Science in Engineering Acoustics-September 2004
Master of Science in Operations Research-September 2004
Advisors: Kevin B. Smith, Department of Physics
Samuel E. Buttrey, Department of Operations Research

Acoustic propagation in the littoral regions of the world, even over short ranges, can be complex at high frequencies (> 5 kHz), and applications such as underwater detection and communications suffer as a result. To this end, the Asian Seas International Acoustics Experiment (ASIAEX) was conducted with funding from the Office of Naval Research.

One phase of this experiment took place from 29 May to 9 June 2001, and focused on short-range, shallow water acoustic propagation in the East China Sea. This thesis is based on some of the measurements taken during the East China Sea experiment by a team from the Applied Physics Laboratory of the University of Washington. The environmental parameters and array geometry used in this and previous modeling work are as close as possible to the experiment.

The objective of this thesis is to better understand the nature of turbulent perturbations and how they affect short-range acoustic propagation in a shallow water environment. This will include variations in total energy of the turbulence, variations in associated length scales, and variations in depth. In addition, the influence of other variable factors on signal coherence is examined. Most notably, variations in background sound-speed structure and source depth variability are included.

KEYWORDS: Shallow Water Variability, Turbulence, Vertical Coherence, Sound Speed Curvature

THE IMPACT OF LONG-TERM AIRCRAFT CARRIER MAINTENANCE SCHEDULING ON THE FLEET READINESS PLAN
Matthew H. Hall-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Science in Operations Research-September 2004
Advisor: W. Matthew Carlyle, Department of Operations Research
Second Reader: CAPT Jeffrey E. Kline, USN, Wayne E. Meyer Institute of Systems Engineering

Maintaining the Fleet Readiness Plan (FRP) construct of six aircraft carriers available within 30 days plus two additional carriers available within 90 days is a difficult task. Maintenance requirements on carriers alone make satisfying the FRP a challenging scheduling problem. A carrier maintenance scheduling model is developed, with the goal of meeting as much as possible, the FRP requirements over a ten-year period, while obeying simple maintenance facility constraints. This model allows users to anticipate gaps in coverage and also to quantitatively assess the benefit, or burden, of re-sizing the fleet. The author concludes that by increasing the average cycle time for a Carrier Strike Group (CSG) to 27 months, the FRP requirements can be met continuously, after an initial maintenance adjustment period of 62 months.

KEYWORDS: Aircraft Carrier Strike Group, CSG, Depot-Level Maintenance Scheduling, Optimization, Fleet Readiness Plan, FRP, Fleet Readiness Training Plan, FRTP, “6+2” Construct, Column Generation
USING HUGHES' SALVO EQUATIONS TO EXAMINE SHIP CHARACTERISTICS IN SURFACE WARFARE
Kevin G. Haug-Lieutenant, United States Navy
B.A., William Jewell College, 1994
Master of Science in Operations Research-September 2004
Advisor: Thomas Lucas, Department of Operations Research
Second Reader: Wayne Hughes, Graduate School of Operational and Information Science

As resources constrain investment decisions, what combination of parameters most effectively cause one force to defeat another? Using Hughes' Salvo equations, simulations are conducted to investigate the singular and pairwise effects of providing one force an advantage in its offensive power, defensive power, staying power, force size and information. The purpose is to identify specific combinations that present potential priorities in ship design and force planning. Cases are examined in terms of fraction of forces killed and surviving, and consolidated in a comparison of fractional exchange ratios between the forces. Over the range of parameters explored, when forces are closely matched, a defensive advantage allows a force to outlast another, execute damage, and limit damage incurred to its own force. The Polya distribution of shots shows that the bonus gained by attaining perfect information is a significant edge, and also shows the hazard of failing to deny the enemy the same.

KEYWORDS: Hughes Salvo Model, Ship Design, Surface Warfare, Simulation

A MULTI-YEAR AMMUNITION PROCUREMENT MODEL FOR NON-NUCLEAR ORDNANCE
Charles E. Hurst, Jr.-Lieutenant Commander, United States Army
B.S., Auburn University, 1991
Master of Science in Operations Research-September 2004
Advisor: W. Matthew Carlyle, Department of Operations Research
Second Reader: Gerald G. Brown, Department of Operations Research

In 2003, the Assessment and Investment Model (AIM) introduced a fiscally constrained ordnance procurement model to plan procurements of the most capable inventory of munitions, while attempting to meet annual Navy Non-Nuclear Ordnance Requirements (NNOR). AIM is the first analytical planning tool to incorporate fiscal constraints, use true optimization to guide procurement policy, and establish a quantifiable measure of overall inventory capability.

This report reformulates AIM and dramatically improves response times for almost all instances. Authors report analyses using AIM, involving a variety of budgeting and inventory scenarios. AIM is now a fast, flexible tool that can handle a wide range of budget and requirements scenarios in a manner that was previously impossible. Decision-makers can now develop a procurement plan that effectively and efficiently meets the ordnance needs of the world’s most powerful Navy.

KEYWORDS: Optimization, Ordnance Procurement Planning

STATISTICAL MONITORING OF SUICIDES IN THE U.S. ARMED FORCES
Matthew K. Martin-Commander, United States Navy
B.S., United States Naval Academy, 1989
Master of Science in Operations Research-September 2004
Advisor: David H. Olwell, Department of Operations Research
Second Reader: Laura A. Barton, Department of Operations Research

This study models Department of Defense suicides as a Poisson process to detect departures from usual variation using a self-starting control chart scheme. Methods are implemented in a Microsoft Excel spreadsheet with Visual Basic macros for ease of use. Persistent shifts in the process mean are detected in the following months for each service component.

- Army: August 1985 (increase), September 1987 (decrease), April 1991 (increase), November 1997 (decrease), and September 2001 (decrease).
OPERATIONS RESEARCH

- Navy: December 1990 (decrease), January 1993 (increase), May 1994 (decrease), July 1995 (increase), and March 1996 (decrease).
- Marine Corps: January 1993 (increase) and March 1998 (decrease).
- Air Force: January 1988 (increase), April 1990 (decrease), November 1994 (increase), November 1998 (decrease), and April 1999 (decrease).

KEYWORDS: Control Chart Methodologies, Statistical Process Control, Suicide Rates

A LINEAR PHYSIOLOGICAL VISUAL-VESTIBULAR INTERACTION MODEL FOR THE PREDICTION OF MOTION SICKNESS INCIDENCE

Panayiotis G. Matsangas-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1992
Master of Science in Operations Research-September 2004
Master of Science in Modeling, Virtual Environments, and Simulation-September 2004
Advisors: Michael E. McCauley, Department of Operations Research
Nita Lewis Miller, Department of Operations Research
Second Reader: Alan R. Washburn, Department of Operations Research

This thesis proposes an etiologic linear model based on human physiology for the explanation of the Motion Sickness Incidence (MSI) found in McCauley, et al. experiments (1974, 1976). The model is based on known theories (sensory conflict, observer theory), physiological processes, and existing models dealing with spatial orientation and motion sickness. It takes into account the basic concepts of time accumulation attribute of motion sickness, the “neural store,” and the addition of vestibulo-ocular reflexes (VOR) and optokinetic nystagmus (OKN) hypothesis. The vestibular and visual human sensory systems and their interactions are studied. The combined error produced in the aforementioned sensory systems used to estimate the Motion Sickness Incidence derives from the normalized error in the estimation of gravity vector in the vestibular system; and the error produced in the visual system due to retinal slip (residual optical flow), because of imperfect compensation from the vestibulo-ocular and optokinetic reflexes. The predicted maxima are at 0.196 [Hz] for gravity estimation error and 0.167 [Hz] for visual error; thus peak MSI lies within this frequency region. The proposed model predicts MSI for two-hour exposure with less than ±5% error, compared to the previous descriptive model and to corresponding experimental data, in the frequency range between 0.07 [Hz] and 0.25 [Hz]. The difference between the proposed model and the human factors research (HFR) experiments is increased at the outer frequency regions of the data. Furthermore, the time prediction of MSI and the corresponding adaptation process are approximated with adequate precision by the proposed model. The difference in predicted MSI between the proposed and the HFR experiments is attributed to the vertical-axis constraint and the lack of proprioception.

KEYWORDS: Human Performance, Motion Sickness, Human Physiology, Human Physiology Modeling

A SURVEY ON TRAINING AND EDUCATION REQUIREMENTS OF MARINE CORPS AVIATION LOGISTICS OFFICERS IN PREPARATION FOR SEA BASING

Roger M. Mishoe-Captain, United States Marine Corps
B.S., Southern University and A&M College, 1999
Master of Science in Operations Research-September 2004
Advisor: Robert A. Koyak, Department of Operations Research
Second Reader: Susan G. Dooley, Department of Operations Research

Sea Basing is a component of Naval transformation that changes the way Marine Corps forces deploy, fight, and are supplied. Implications of Sea Basing for Marine aviation logistics officers who have depended on a network of land-based systems to support Marine units engaged in military operations is considered. Marine aviation logisticians are faced with the challenge of supporting Marine forces from the sea, and at distances much greater than before.

Results of a statistical survey conducted of the four military occupational specialties that comprise the Marine aviation logistics community are described: supply, maintenance, avionics, and ordnance. The survey reached nearly 44 percent of aviation logistics officers and asked respondents to rate the importance
of different types of training to help prepare them for Sea Basing. It is found that Marine aviation logistics officers highly rate training in acquisition, advanced specialty training, and joint training. Officers rate the importance of training in these areas differently, depending on the specialty of the officer. In addition, many officers regard training in supply-chain management as an important factor in making a successful transition to a Sea Base.

**KEYWORDS:** Sea Basing, Marine Transformation, Marine Aviation Logistics, Training and Education, Acquisition, Supply-chain Management

**AN ANALYSIS OF THE EFFECTIVENESS OF A NEW WATCHSTANDING SCHEDULE FOR U.S. SUBMARINERS**

Christopher M. Osborn-Lieutenant, United States Navy Reserve  
B.S., Auburn University, 1997  
Master of Science in Operations Research-September 2004  
Advisors: Nita Lewis Miller, Department of Operations Research  
Jeffrey Crowson, Department of Operations Research  
Second Reader: Lyn R. Whitaker, Department of Operations Research

This study compares an experimental watchstanding schedule derived at Naval Submarine Medical Research Laboratory (NSMRL) with the schedule currently used onboard the submarine USS HENRY M. JACKSON (SSBN 730 GOLD). It analyzes subjective and objective data to determine if the new schedule is compatible in an operational submarine environment. This study reviews sleep and fatigue literature to emphasize important concepts needed to make schedule comparisons. Results from this study indicate the need for the U.S. submarine force to employ an operational schedule which provides more sleep and which is in better alignment with human circadian rhythms, thus improving cognitive effectiveness. One of the experimental schedules tested in this study yielded results similar to those of the existing submarine watchstanding schedule. This experimental schedule employs a validated model of human performance and fatigue to assess individual cognitive effectiveness. However, the results also indicate that the existing schedule is better suited in its accommodation of operational scheduling constraints which, in turn, allow watchstanders to receive more sleep. Recommendations address the need for the U.S. submarine force to continue to pursue a watchstanding schedule that provides better sleep while still accommodating operational constraints. Recommendations also address improvements in experiment implementation which can be integrated into future studies.

**KEYWORDS:** Sleep, Circadian Rhythm, Submarine, Watchstanding Schedule, Actigraph, Fatigue Avoidance Scheduling Tool, FAST, Effectiveness, Performance, Rotating Shift, Survey

**AN OPTIMIZATION MODEL FOR SEA-BASED LOGISTICS SUPPLY SYSTEM FOR THE NAVY AND MARINE CORPS**

Donato S. Powell-Captain, United States Marine Corps  
B.S., University of California-Davis, 1997  
Master of Science in Operations Research-September 2004  
Advisor: Javier Salmeron, Department of Operations Research  
Second Reader: David A. Schrady, Department of Operations Research

The United States is moving into a new era in which the enemy no longer provides symmetric opposition. The Navy and Marine Corps will face new challenges in the way they deploy and conduct future operations. One important way that these challenges will be met involves sea-based operations, which provide the sustainment necessary for prolonged operations and prevent unwanted operational pauses.

Recent combat operations in Operation Iraqi Freedom (OIF) demonstrated difficulties when sustaining forces from logistics bases ashore. For example, advancing the Army and Marines to Baghdad in OIF consumed large amounts of fuel and ammunition. The resupply could not replenish supplies and an operational pause began on 29 March, 2003. In order to prevent operational pauses, rapid movement from the sea to the objective must be implemented.
This thesis analyzes the problem of finding an optimal mix of Combat Logistics Force shuttle ships required to sustain the sea-base. This is accomplished through two optimization models. The first model determines a shuttle mix ensuring that required inventory levels at the sea-base are maintained at all times. Since this requirement may cause some shuttles to be partially loaded, in the second model the shuttle mix is assigned manually, and unmet demand is minimized. This model yields a mix of shuttles that strikes a balance between shuttle cost and meeting sea-base demand. This thesis uses varying distances for conducting analyses over several scenarios.

KEYWORDS: Sea-based Logistics, Network Optimization

UNMANNED AERIAL VEHICLE CONTRIBUTIONS TO INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE MISSIONS FOR EXPEDITIONARY OPERATIONS

Mark A. Raffetto-Captain, United States Marine Corps
B.A., Potsdam College, 1991
Master of Science in Operations Research-September 2004
Advisor: Thomas W. Lucas, Department of Operations Research
Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

This study analyzes the impact of various capabilities on intelligence gathering missions for a Marine Expeditionary Brigade (MEB) Commander’s 2015 unmanned aerial vehicle (UAV). The Marine Corps Warfighting Lab (MCWL) is developing requirements for an intelligence, surveillance, and reconnaissance (ISR) UAV that supports rapid planning and decision-making for multiple concurrent operations and facilitates maneuver and precision engagement. Additionally, acquisition of a 2008 Pioneer replacement is underway at Marine Corps Systems Command (MARCORSYSCOM). The importance of various capabilities for this replacement UAV presently lacks quantitative analysis. Through modeling, agent-based simulation, and data mining, this study explores the validity of current requirements and provides insights into the importance of various UAV characteristics, such as airspeed, endurance, sweep width, and sensor capability. The results have design consequences for MCWL’s Fleet Battle Experiment Sea Viking 20XX, its largest annual experiment, and provide key parameters for physics-based simulations, such as COMBAT XXI. The advantage of tactical routing, a seven hour (or greater) on station time, a minimum 4,500 meter sweep width, and a probability of classification of at least 0.4 are verified for the Sea Viking scenario. This analysis indicates that a UAV in this scenario does not need to travel in excess of 200 knots.

KEYWORDS: Unmanned Aerial Vehicle, UAV, Agent-based Models, MANA, Project Albert, Latin Hypercube, Design of Experiment, Expeditionary, ISR, IPB, MEB

DETECTION OF ERRONEOUS PAYMENTS UTILIZING SUPERVISED AND UNSUPERVISED DATA MINING TECHNIQUES

Todd E. Yanik-Lieutenant Commander, United States Navy
B.S., West Virginia University, 1990
Master of Science in Operations Research-September 2004
Advisor: Samuel E. Buttrey, Department of Operations Research
Second Reader: Lyn R. Whitaker, Department of Operations Research

In this thesis, a procedure for detecting erroneous payments in the Defense Finance Accounting Service, Internal Review’s (DFAS, IR) Knowledge Base Of Erroneous Payments (KBOEP) is developed, with the use of Supervised (Logistic Regression) and Unsupervised (Classification and Regression Trees (C&RT)) modeling algorithms. S-Plus software is used to construct a supervised model of vendor payment data using Logistic Regression, along with the Hosmer-Lemeshow Test, for testing the predictive ability of the model. The Clementine Data Mining software is used to construct both Supervised and Unsupervised modeling of vendor payment data using Logistic Regression and C&RT algorithms. The Logistic Regression algorithm, in Clementine, generates a model with predictive probabilities, which are compared against the C&RT algorithm. In addition to comparing the predictive probabilities, Receiver Operating Characteristic (ROC) Curves are generated for both models to determine which model provides the best results for a Coincidence Matrix’s True Positive, True Negative, False Positive and False Negative
Fractions. The best modeling technique, C&RT, is selected and given to DFAS, IR to assist in reducing the manual record selection process currently being used. A recommended ruleset is provided, along with a detailed explanation of the algorithm selection process.

**KEYWORDS:** Data Mining, Erroneous Payments, Logistic Regression, Hosmer Lemeshow Test, Classification and Regression Trees, Receiver Operator Characteristic Curves, Supervised and Unsupervised Modeling.
Knowledge of transport parameters is important to the development of new optoelectronic materials and devices, such as ultraviolet (UV) semiconductor lasers and advanced solar cells. A series of experiments is performed to measure fundamental transport parameters in luminescent semiconductor materials. Using a technique that couples a scanning electron microscope (SEM) in spot mode with a charge coupled display (CCD) camera, it is possible to image the recombination of charge created at a point. The goal is to extract fundamental transport parameters, such as minority carrier diffusion length (\(L_{\text{diffusion}}\)) and drift length (\(L_{\text{drift}}\)), with high spatial resolution. Direct transport imaging is used to study diffusion without bias and drift under a range of applied electric fields. The recombination distribution as a function of applied bias is imaged. For the unbiased measurements, the results show that for bulk n-type GaAs the spotwidth was independent of probe current, indicating the luminescence distribution is primarily a function of generation volume and not diffusion length. For thin layer samples that could be approximated as two dimensional (2D), it is found that the spotwidth changes as a function of probe current, indicating the potential to extract diffusion length data. Results are compared to numerical modeling of charge transport and the feasibility and limitations of this method for contact-free measurements of lifetime (\(\mu\)) and mobility (\(\tau\)) are assessed.

**KEYWORDS:** Contact-less Measurements, Diffusion, Drift, Semiconductors, Transport Imaging
The Department of Defense (DoD) has recognized the value of quality management programs for contractors since the establishment of the MIL-Q-9858 program in 1959. However, the application of quality management programs and principles within DoD has been accomplished with many and varied approaches, often service and organization specific. Policy guidance on the use of quality management within DoD is limited to non-existent. ISO 9001:2000 has been successfully used by industry and is a recognized quality management system for the execution of DoD contracts, principally for production or manufacturing. This case study examines the application of the ISO 9001:2000 standard to a government organization conducting research, development, test and evaluation for the U.S. Navy and assesses the benefits, drawbacks and effectiveness of using ISO 9001:2000 within a DoD organization.

KEYWORDS: ISO 9000:2000, Six Sigma, Capability Maturity Model Integration, CMMI, Undersea Warfare, Total Quality Management, TQM, Quality Management System, QMS
In the past ten years, military operations, as now evident in Iraq, have involved both joint-Allied and coalition forces. The evolving joint- and coalition-warfare environment presents coordination challenges. Collaborative tools can ease the difficulties in meeting these challenges by enabling highly interactive work to be performed by individuals not necessarily geographically co-located. Collaborative tools will revolutionize the manner in which distributed warfighters interact and inform each other of mission-planning progress and situation assessments. These systems allow warfighters to integrate tactical information with key combat-support logistics data in both joint- and coalition-warfare environments. Countless collaboration tools and knowledge management systems exist today. Unfortunately, industry has developed these tools and systems for use primarily in exclusive communities of interests, services, or agencies. The end result is a proliferation of tools that are not designed to operate under all network conditions. Since network conditions are not standardized in the joint- and coalition-warfare environment, it is necessary to determine whether a collaborative tool can perform under limited-bandwidth and latency conditions. Currently, there are neither evaluation criteria nor methodologies for evaluating collaborative tools with respect to performance reliability. This thesis proposes a test methodology for evaluation of performance reliability of collaborative tools, and demonstrates the effectiveness of the methodology with a case study of the performance evaluation of the InfoWorkSpace collaborative tool.

KEYWORDS: Collaboration, Collaborative Tools, Software Reliability, Performance, Bandwidth, Latency, Network, DISA, CMO, DIA, JIVA, USJFCOM, CIE, Communications Resiliency, Test Case, IWS, DCTS, DoD, COTS, MCU, NGCS, XML, GROOVE, WEBBE, GDSS, Groupware

The purpose of this research is to define a centralized database containing all necessary information related to the daily management of an industrial and commercial organization that is publicly owned and equipped with civilian personnel and financial autonomy. The system is composed of the following subsystems:

- Subsystem “Human resource management”
- Subsystem “Provisioning”
- Subsystem “Financial, budgetary, and accounting management”

The three subsystems should be installed in a central site and at regional sites. Each site will have its own database. The central database will be supplied with the data, which comes from the other sites at the end of the day (or according to need) via modems. It is necessary to develop a tool for remote database queries in order to accomplish this work. The platform on which the application must be executed is IBM-INFORMIX running on top of the WINDOWS operating system. The database will be a relational database. The framework used in the design and modeling consists of:
SOFTWARE ENGINEERING

- Object Oriented Analysis (OOA), which enables the development of high quality software by defining the problem structure.
- The Delphi Language, which provides a robust development environment.

The installation of the solution will be executed according to the following scenario:
- Client/Server architecture with the object oriented development tool DELPHI.
- The database will be installed on the central and regional servers.
- The application will be installed on the end users’ stations.
- Data access will be through an open ODBC.

This software presents an integrated solution that provides centralized and accurate data, so that data is used to derive the right decision at the best time.

INVESTIGATION OF OUTER LENGTH SCALE IN OPTICAL TURBULENCE USING AN ACOUSTIC SOUNDER

Jeffrey T. Douds-Captain, United States Army
B.S., University of Colorado at Colorado Springs, 1993
Master of Science in Space Systems Operations-September 2004
Advisor: Donald L. Walters, Department of Physics
Second Reader: Richard C. Olsen, Department of Physics

This thesis examines the horizontal separations between convective thermal plumes and features within a thermal plume through the use of an acoustic sounder, an anemometer, and extensive data analysis. The mean, standard deviation, median, and mode are calculated for the computed correlation lengths of the acoustic sounder data sampled in time intervals of two, five, and ten minutes.

The data sampled at two and five minute intervals emphasize features within an individual thermal plume. The mean correlation distances found for two and five minute intervals are 81 meters ± 70 meters and 89 meters ± 72 meters, respectively. Their medians are 61 meters and 69 meters; and their modes are 41 meters and 50 meters, respectively.

The ten minute time interval statistics use a low pass filter to emphasize larger scale features. The mean correlation length is 494 meters ± 373 meters, the median is 391 meters and the mode was 316 meters. These distances represent the distance between the center of a plume and the center of a quiet region adjacent to that plume.

KEYWORDS: Atmospheric Structure Parameter, Atmospheric Turbulence, Outer Length Scale, Acoustic Sounder, Optical Turbulence

OPTIMIZING COVERAGE AND REVISIT TIME IN SPARSE MILITARY SATELLITE CONSTELLATIONS: A COMPARISON OF TRADITIONAL APPROACHES AND GENETIC ALGORITHMS

Douglas J. Pegher-Lieutenant, United States Navy
B.A., Edinboro University of Pennsylvania, 1993
Master of Science in Space Systems Operations-September 2004
Advisor: Charles M. Racoosin, Naval Space Systems Academic Chair Professor
Second Reader: David Trask, Measurement and Signals Intelligence Chair Professor

This thesis compares two design methods of sparse military satellite constellations: a traditional approach and a genetic approach. One of the traditional constellation designs was the Discoverer II space based radar. Discoverer II was an 8 plane, 24 satellite, Low Earth Orbit (LEO), Walker constellation designed to provide high-range resolution ground moving target indication (HRR-GMTI), synthetic aperture radar (SAR) imaging, and high resolution digital terrain mapping. The traditional method designed 9-ball, 12-ball, 18-ball, and 24-ball Walker constellations. The genetic algorithm created constellations by deriving a phenotype from a triploid genotype encoding of orbital elements. The performance of both design methods are compared using a computer simulation. The fitness of each constellation is calculated using maximum gap time, maximum revisit time, and percent coverage. The goal is to determine if one design method would consistently outperform the other. The genetic algorithm offers a fitness improvement over traditional constellation design methods in all cases except the 24-ball constellation, where it demonstrates comparable results. The genetic algorithm improvement over the traditional constellations increases as the
number of satellites per constellation decreases. A derived equation relates revisit time to the number of ship tracks maintained.

**KEYWORDS:** Constellation Design, Space Based Radar, Synthetic Aperture Radar, Ground Moving Target Indicator, Surface Moving Target Indicator, Genetic Algorithms

**THE INTERNATIONAL SPACE STATION COMPARATIVE MAINTENANCE ANALYSIS MODEL (CMAM)**

Brian T. Soldon-Major, United States Army  
B.S., United Stated Military Academy, 1993  
Master of Science in Space Systems Operations-September 2004  
Advisor: Chirold Epp, Michael J. Smith National Aeronautics and Space Administration Chair Professor  
Second Reader: CAPT Daniel Bursch, USN, Space Systems Academic Group

This thesis describes the current model, the Reliability and Maintainability Assessment Tool (RMAT), used by NASA and related prime contractors for the forecasting of Orbital Replacement Unit (ORU) failure rates and associated maintenance demands for the International Space Station (ISS). A new model, the Comparative Maintenance Analysis Tool (CMAM), is introduced and developed for replicating some of the basic functionality of RMAT in order to provide a comparative look at RMAT results. The CMAM program, developed in Visual Basic.net and dynamically linked to a Microsoft ACCESS database, focuses on a representative set of critical Orbital Replacement Units that represent key items that require both internal and external maintenance in both pressurized and un-pressurized storage) and generated failure rate data for each critical ORU. The results of the CMAM model are then compared with the failure rates generated by RMAT program for the same set of critical ORUs. These two independently developed sets of data are then analyzed against historic failure rates for these ISS parts.

The results of this analysis are used to conduct a sensitivity analysis of both the CMAM and RMAT programs in order to help identify the primary contributing factors behind divergence issues between forecasted/predicted failures and associated maintenance from actual (historical) failure rates.

Recommendations are provided, based upon the results of the comparison, with respect to the sensitivity of RMAT to changes in certain input parameters, as well as on the feasibility of implementing CMAM as a comparative tool for use by both NASA and Boeing logistics and management (L&M) personnel for the purpose of RMAT sensitivity analysis, and for use in initial operational planning for optimizing ORU stocking levels while awaiting more comprehensive RMAT results.

**KEYWORDS:** International Space Station, Comparative Maintenance Analysis Model, CMAM, Reliability and Maintainability Analysis Tool, RMAT, Orbital Replacement Unit, ORU, Logistics Supportability Assessment Report, LSAR, Intra-vehicular Activity, IVA, Extra-vehicular Activity, EVA, Extra-vehicular Robotics, EVR, Corrective Maintenance, CM, Preventative Maintenance, PM, FORTRAN, Visual Basic.NET, EXCEL, ACCESS, EXCEL, Crystal Ball, Graphic User Interface, GUI, Mean Time Between Failures, MTBF
MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

DEVELOPMENT OF CODE FOR A PHYSICAL OPTICS RADAR CROSS-SECTION
PREDICTION AND ANALYSIS APPLICATION
Filippos Chatzigeorgiadis-Major, Hellenic Air Force
B.S., Hellenic Air Force Academy, 1990
Master of Science in Systems Engineering-September 2004
Master of Science in Electrical Engineering-September 2004
Advisors: David C. Jenn, Department of Electrical and Computer Engineering
D. Curtis Schleher, Department of Information Sciences

The significance of the Radar Cross Section (RCS) in the outcome of military engagements makes the prediction of RCS an important problem in modern Electronic Warfare. The POFACETS program, previously developed at the Naval Postgraduate School (NPS), uses the Physical Optics method to predict the RCS of complex targets, which are modeled with the use of triangular facets. The program has minimum computer resource requirements and provides convenient run-times. This thesis upgrades, enhances, and expands the functionalities and capabilities of the POFACETS program. The new functionalities are implemented by upgrading the Graphical User Interface and model database, allowing the creation of models with an unlimited number of facets, providing capabilities for the automatic creation of models with standard geometric shapes, allowing the combination of existing target models, providing capabilities for sharing target models with commercial CAD programs and creating new display formats for RCS results. The new computational capabilities include the development of a database, available for user update, of materials and coatings that can be applied to models in one or multiple layers, and the computation of their effects on the models' RCS. Also implemented are the computations of the ground's effect on the RCS, and the exploitation of symmetry planes in models, in order to decrease run-time for RCS prediction.

KEYWORDS: Physical Optics, Radar Cross Section, Monostatic, Bistatic, Electromagnetic Scattering, Graphical User Interface, Faceted Models

EFFECTIVENESS OF USING RED-TEAMS TO IDENTIFY MARITIME SECURITY VULNERABILITIES TO TERRORIST ATTACK
Anna M. Culpepper-Lieutenant, United States Navy
B.A., William Marsh Rice University, 1997
Master of Science in Systems Engineering-September 2004
Advisors: Raymond Buettner, Department of Information Sciences
Dorothy Denning, Department of Defense Analysis

As the United States continues to develop plans and policies to counter the threat of terrorism, it becomes increasingly more vital to understand the entire spectrum of the threat. Realistically assessing the capability of possible and probable terrorist groups helps federal and state agencies establish potential methods and procedures for defense and maritime domain awareness. Yet, the avenues of attack and the varieties of terrorists far outnumber the available resources of most agencies concerned. Moreover, there have been no attacks on homeland U.S. targets since September 11. The red team concept provides an innovative method to examine these vulnerabilities from the terrorist perspective. The effectiveness of a red team can be measured in various ways and is dependent on key organizational and situational elements. In the end, the determination of effectiveness is based on the original intentions of the host enterprise, whether it is training, research, strategy, analysis, or a combination. A case study is conducted, utilizing the red team concept as a tool for bringing a fresh awareness to a critical issue within the National Strategy for Combating Terrorism. The red teams identify vulnerabilities of possible targets, raise the awareness on the nature of terrorists, research potential tactics and tools, and examine existing assumptions about
maritime security. In applying the red team concept, the case study uses military officers as surrogate terrorists planning a campaign to attack port cities. The case study effectively demonstrates the anticipated functions, while the follow-on actions ensure that the results are distributed to the appropriate agencies. Furthermore, civilian officials and the agencies concerned value the red team reports as positive insights into the current situation.

KEYWORDS: Information Operations, Red Team, Operations Research, Terrorism, Defense Analysis

NETWORK-CENTRIC STRATEGIC-LEVEL DECEPTION
Philip B. Erdie-Captain, United States Marine Corps
B.S., University of Arizona, 1995
Master of Science in Systems Engineering-September 2004
Advisors: James Bret Michael, Department of Computer Science
Raymond Buettner, Department of Information Sciences

This thesis explores strategic-level deception in the context of network-centric information operations. Advances in information technology and the global connectedness of communications networks have created new opportunities and challenges for conducting strategic and operational level deception campaigns with significant utilization of cyberspace. Planning and executing concurrent strategic-level deceptions among distributed participants and against multiple targets requires speed, flexibility and situational awareness. This thesis includes a historical account of twentieth century use of strategic-level deception, defines network deception, discusses considerations for achieving network based deception, and proposes a model of command structure for network-centric planning and execution of deception campaigns in the twenty-first century.

KEYWORDS: Network-center Information Operations, Information Technology, Strategic-level Deception, Network Deception, Network-centric Planning and Execution, Deception Campaigns

NAVAL POSTGRADUATE SCHOOL ANECHOIC CHAMBER EVALUATION
Burcak Erenoglu-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1999
Master of Science in Systems Engineering-September 2004
Advisor: David C. Jenn Department of Electrical and Computer Engineering
Second Reader: D. Curtis Schleher, Department of Information Sciences

Antennas are designed for specific system requirements such as gain, radiation pattern, bandwidth, input impedance, and patterns. During this design and testing process, one of the most important steps is the measurement of the antenna’s radiation pattern to define these critical parameters. Anechoic chambers are used for indoor testing purposes. Ideally, they are isolated from all electromagnetic noise and have absorber coated walls inside. Anechoic chambers are also used for radar cross-section (RCS) measurements and electromagnetic interference tests.

This thesis examines the performance of the current Naval Postgraduate School anechoic chamber. Different absorbers and antenna patterns are simulated using the Urbana Wireless Toolset. This thesis also includes a noise evaluation of the anechoic chamber. The results of this thesis can be used to guide the users of the existing chamber configuration in setting up tests and can assist in any future redesign.

KEYWORDS: Propagation Mechanisms, High Frequency Electromagnetic Calculation Techniques, Anechoic Chambers, Absorber Coating, Noise Measurements
SIDELOBE CANCELLER JAMMING USING HOT-CLUTTER
Sargun Goktun-Major, Turkish Air Force
B.S., Turkish Air Force Academy, 1990
Master of Science in Systems Engineering-September 2004
Ercan Oruc-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1998
Master of Science in Systems Engineering-September 2004
Advisor: D. Curtis Schleher, Department of Information Sciences
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

Coherent Sidelobe Cancellation (CSLC) is a coherent processing technique that has the potential to reduce noise jamming through the antenna side lobes. Present CSLCs can reduce the noise jamming by 25 to 35dB. The maximum number of side lobe jammers that a CSLC can handle is equal to the number of auxiliary antennas.

The performance of CSLC is governed by nonlinear stochastic differential equations that are not solvable by analytic means. Therefore, this thesis employs simulation to solve these equations.

The CSLC becomes saturated as the number of jammers in different directions exceeds the number of loops. Jammer multipaths add an additional degree of freedom for each multipath signal that has a direction different than that of the main jammer.

The objective of this thesis is to determine the effect that these multipath or hot clutter signals have on a CSLC. It is found that hot clutter produces substantial degradations on single, double, and triple CSLCs. The effect is most pronounced for single cancellers where multipath with magnitude 1% of the jamming signal reduce the cancellation ratio by 18dB. Comparable numbers for double and triple cancellers are 11dB.

KEYWORDS: Sidelobe Canceller, Hot-clutter

SENSOR FUSION FOR BOOST PHASE INTERCEPTION OF BALLISTIC MISSILES
I. Gokhan Humali-First Lieutenant, Turkish Air Force
B.S., Turkish Air Force Academy, 1996
Master of Science in Systems Engineering-September 2004
Advisors: Phillip E. Pace, Department of Electrical and Computer Engineering
Murali Tummala, Department of Electrical and Computer Engineering

In the boost phase interception of ballistic missiles, determining the exact position of a ballistic missile is extremely important. Several sensors are used to detect and track the missile. These sensors differ from each other in many different aspects. The outputs of radars give range, elevation, and azimuth information on the target, while space based infrared sensors give elevation and azimuth information. These outputs must be combined (fused) to achieve better position information for the missile. The architecture used in this thesis is decision level fusion architecture. This thesis examines and compares four algorithms to fuse the results of radar sensors and space based infrared sensors: an averaging technique, a weighted averaging technique, a Kalman filtering approach, and a Bayesian technique. The ballistic missile boost phase segment and the sensors are modeled in MATLAB. The missile vector and dynamics are based upon Newton’s laws and the simulation uses an earth-centered coordinate system. The Bayesian algorithm has the best performance resulting in a rms missile position error of less than 20 m.

KEYWORDS: Ballistic Missile Defense System, Boost Phase Interception, Sensor Fusion, Radar Design, IR Satellites
Organizational change for the purpose of improving performance is extremely challenging, particularly for government institutions. Large bureaucracies, hierarchical structures, and deeply rooted work cultures are some characteristics of governmental organizations that have proven to be serious impediments to performance improving change. In May 2003, the Naval Aviation Depot North Island Engineering Competency (NAVAIRNI 4.0) began a transformational process to improve organizational performance by providing higher value to its customers, generating higher quality of products and services, and attaining better financial performance. The purpose of this thesis is to analyze the experience of government organizations in implementing performance related change efforts such as Total Quality Management (TQM), Business Process Reengineering (BPR), and Activity Based Costing (ABC). Specifically, this thesis identifies leadership characteristics and strategies employed by public firms during successful transformation initiatives. By isolating leadership traits associated with these successful change efforts, this thesis develops a simplified relational model that can provide NAVAIRNI 4.0 and other government organizations with effective leadership concepts for use in their own endeavor.

KEYWORDS: Leadership, High-performance Organizations, Organizational Change, Organizational Transformation, Diagnostic Change Model, Performance Improvement

The fast frequency-hopping technique is considered one of the most effective Electronic Protective Measures (EPM) used by military communications systems to mitigate the effect of a follower or repeat jammer.

This thesis evaluates the performance of different jamming strategies, such as barrage noise jamming, partial band jamming and multitone band jamming against an uncoded noncoherent fast frequency-hopped M-ary frequency-shift keying (FFH/MFSK) system with a conventional receiver.

The theoretical and simulated results showed that the best jamming strategies for the examined modulation orders $M=2,4,8$ is the optimum case of multitone band jamming.

This thesis also provides a preliminary analysis of an uncoded noncoherent FFH/MFSK system in a Rayleigh fading channel. This analysis includes theoretical and simulated results for the influence on performance from a barrage noise jammer along with additive white Gaussian noise (AWGN).

The results of the theoretical analysis and the simulation modeling for both cases can be used as guidelines to analyze more complicated jamming or combinations of jamming strategies against FFH/MFSK communication systems.

KEYWORDS: FFH/MFSK, Square-law Linear Combining Receiver, Probability of Bit Error, Follower Jammer, Barrage Noise Jamming, Partial-band Jamming, Multitone Band Jamming, Gaussian Channel, Rayleigh Channel, Systemview, Simulation Model
PROTOTYPE SYSTEM FOR DETECTING AND PROCESSING OF IEEE 802.11G SIGNALS
Georgios Kypriotis-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1994
Master of Science in Electrical Engineering-September 2004
Master of Science in Systems Engineering-September 2004
Advisor: Tri T. Ha, Department of Electrical and Computer Engineering
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

On the modern battlefield, successful and fast communications is a critical issue, thus increasing the need for transmitting information in larger amounts through a military high-speed network. The military is seeking viable and effective solutions to fulfill these requirements in an operational environment.

This thesis develops and evaluates a prototype system based on appropriate low-cost software and hardware solutions. This system is able to detect, analyze, and process wireless 802.11g signals. The evaluation of the newly designed system proves that it is effective up to distances of about 400 m with a low packet error rate and could be a useful tool for detecting wireless 802.11g networks. Following evaluation, the system is used for capturing wireless signals so that the effective transmission range and the data throughput of an 802.11g network can be assessed. It is determined that such a wireless network can be used in military operations because it offers high data rates up to 200 m, while maintaining a connection of the wireless clients for distances up to 400 m. In addition, the performance data collected can be used as guidelines for estimating the expected performance in an operational situation and can provide useful information for successful planning.

KEYWORDS: Wireless Transmission Protocol, IEEE 802.11g, Wireless LAN, Data Throughput, Transmission Rate

AN ANALYSIS OF TESTING RISKS: A STRATEGY FOR MITIGATION
Albert G. Mousseau, Jr.-Lieutenant Commander, United States Navy
B.S., Worcester Polytechnic Institute, 1990
Master of Science in Systems Engineering-September 2004
Advisors: John T. Dillard, Graduate School of Business and Public Policy
Scott Weed, Naval Air Systems Command Weapons Systems Engineering Division
Second Reader: Walter E. Owen, Graduate School of Business and Public Policy

The Department of Defense is constantly trying to improve the product development effort for its weapon systems. As the complexity of those systems increases, so does the importance of the test and evaluation process. All services have been victims of poor performance in the independent Operational Evaluation of their respective weapon systems. With the drive to deliver products rapidly to the warfighter, the prospect for success in Operational Test is reduced. Years of neglect and funding reductions have resulted in a decaying test infrastructure. The acquisition community’s failure to consistently apply lessons learned and best business practices ensures that mistakes will be repeated. The U.S. Navy is embarking on an aggressive six-year development effort to retrofit the aging High Speed Anti-Radiation Missile with advanced technology and net-centric enabling systems. This Sea Power 21 weapon will require a test strategy that can effectively verify and evaluate product maturity before independent operational testing. Applying best business practices, lessons learned, and understanding the current state of affairs with respect to the range infrastructure, the Advanced Anti-Radiation Guided Missile Test and Evaluation Integrated Product Team can develop a test approach to mitigate the risk of operational test failure.

KEYWORDS: Test and Evaluation, Systems Engineering, AARGM Weapon System, Range Infrastructure, Lessons Learned
The purpose of this research is to examine the effects of frequency and polarization on radio wave propagation in urbanized areas for unmanned aerial vehicle (UAV) data links and command and control. The transmission from a UAV operating over a small city is simulated using the Urbana Wireless Toolset. Parameters that are varied include frequency, antenna polarization, UAV altitude and building materials. Multiple reflections and diffractions are included in the simulation. In each case, signal contours are generated at discrete frequencies over a 50 MHz bandwidth. It is observed that the signal levels vary up to over the bands at a fixed observation point due to frequency-dependent reflection and diffraction.

**KEYWORDS:** Unmanned Aerial Vehicles, Propagation Models, Urbana Wireless Toolset, Frequency Diversity, Polarization Diversity, Communication and Data Links

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Since the Maastricht Treaty, the European Union (EU) operates under three key pillars. The second pillar, known as the Common Foreign and Security Policy (CFSP), introduced the need among member states to develop a common European Security and Defense Policy (ESDP). Aimed at providing police and military capabilities to the CFSP, this idea represented a new and important element in the European integration progress. ESDP was launched formally in June 1999, with the establishment of ESDP’s mission roots, known as the three “Petersberg Tasks”: (1) Humanitarian and Evacuation Missions, (2) Peace Keeping Missions, and (3) Combat Missions for Crisis Management. The aim of the EU was to upgrade its role and influence in the international arena, though with no intention of overtaking NATO's role in the field of collective defense. The purpose of this thesis is to demonstrate the perspectives for the development of European Security and Defense Policy and to stress the need to consider Electronic Warfare a critical asset in the military and technological capability options. The need for common operational concepts, doctrines, and training, especially in the field of EW, becomes a necessity as Joint EU Armed Forces report active and ready to manage regional and international crises. However, the study of ESDP’s current status shows that EW, an important military component, has been addressed but not emphasized properly. In order to demonstrate EW’s “weight,” an imaginary scenario named “Save Atlantia 2008” has been created in which an advanced software program (i.e., IMOM model) simulates EW effects. The Improved Many-on-Many (IMOM) computer software, presently used by the U.S. Air Force to model the Electronic Order of Battle (EOB), will be used to model the Radar and Tactical Jamming System and conclusions will be based on the theoretical expected jamming effectiveness of the Joint European Air Force against several radar systems in the imaginary scenario.

**KEYWORDS:** European Union, EU, European Security and Defense Policy, ESDP, NATO, Electronic Warfare, EW, IMOM Model
LEVERAGING THE NATIONAL GUARD’S EXISTING INFORMATION TECHNOLOGY INFRASTRUCTURE TO BRIDGE THE INCIDENT RESPONSE DIGITAL DIVIDE

Stephan J. Picard-Major, United States Army
B.S., Eastern Connecticut State University, 1992
Master of Science in Systems Engineering-September 2004
Advisor: William J. Welch, Department of Information Sciences
Second Reader: Maureen Lischke, National Guard Bureau

One of the greatest challenges facing the United States after a concerted terrorist attack is that of coordinating response from the myriad of resources available to the incident commander. During crisis, the daunting task facing the Information Technology (IT) community is to bring a myriad of disparate systems and their relevant traffic together to provide the incident commander a picture of what is happening on the ground, a common operating picture, and then to push that picture up to the decision-makers at the state and federal levels.

This thesis examines current organizational structures, missions and IT architectures within the United States Department of Homeland Security, United States Northern Command and the United States National Guard. In addition, this thesis proposes that one solution to bridge the divide between the disparate agencies that may respond to an emergency, such as a natural disaster or a terrorist Weapon of Mass Destruction (WMD), may exist within the National Guard. With its unique role as a state militia and a federal warfighter, the National Guard is particularly well positioned to bridge this divide by augmenting its existing networks and incident response communications capabilities.


AIRBORNE UBIQUITOUS SURVEILLANCE AND MONITORING NETWORK

Axel Schumann-Kapitänleutnant, Federal German Navy
Electrical Engineer, Armed Forces University Munich, 1996
Master of Science in Systems Engineering-September 2004
Master of Science in Information Technology Management-September 2004
Advisor: Alexander Bordetsky, Department of Information Sciences
Second Reader: David Netzer, Center for Defense, Technology and Education for Military Services

This thesis examines the emergence of wireless technology as a pragmatic baseline supporting the goals of the Department of Defense in the development of Network Centric Forces. Increased international attention to the field of surveillance has developed in conjunction with the desire to interconnect all possible friendly forces in military operations and the Global War on Terror (GWOT).

Ubiquitous surveillance is accomplished by prototyping a network node that is then integrated onboard a military-type unmanned aerial vehicle (UAV).

Although the commercial-off-the-shelf network solution itself is broadly deployed, little is currently known regarding the operation and management of an airborne surveillance network node. This thesis suggests that the use of unmanned aerial vehicles for networking purposes is not only possible, but manageable, even with remote operation of the unmanned aerial vehicle. The documented experiments, conducted over three generations of prototypes, provide insight about how network infrastructure independence for the purpose of surveillance can be reached.

KEYWORDS: Surveillance, Airborne, Network, Wireless, 802.11, Unmanned Aerial Vehicle, UAV, Network Operations
PERFORMANCE ANALYSIS OF WIRELESS LAN SIGNALS TRANSMITTED OVER A RICEAN FADING CHANNEL IN A PULSED-NOISE INTERFERENCE ENVIRONMENT
Evangelos Spyrou-Captain, Hellenic Air Force
B.S., Hellenic Air Force Academy, 1992
Master of Science in Electrical Engineering-September 2004
Master of Science in Systems Engineering-September 2004
Advisor: R. Clark Robertson, Department of Electrical and Computer Engineering
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

This thesis examines the performance of the waveforms specified by the IEEE 802.11a wireless local area network standard, when the signal is transmitted over a Ricean fading channel with additive white Gaussian noise (AWGN) and pulsed-noise interference. The pulsed interference is assumed to be of constant power and is either fading or non-fading. The probability of bit error is conditional on the received signal-to-noise power ratio that is modeled as a random variable. The probability density function of this variable is obtained analytically or numerically for each modulation type and the probability of bit error is evaluated as the expected value of the conditional probability. In one case, a new technique is used to evaluate the inverse Laplace transform in order to evaluate numerically the signal-to-noise ratio probability density function. Due to the complexity of the analysis when both the signal and the interference are subject to Ricean fading, the evaluation is simplified by assuming Ricean signal fading with Rayleigh interference fading and vice versa. The results of the analysis show that performance is affected by the degree of signal fading and the pulsed interference duty cycle. The signal-to-interference power ratio affects the way that performance depends upon these two factors.


REQUIREMENTS AND LIMITATIONS OF BOOST-PHASE BALLISTIC MISSILE INTERCEPT SYSTEMS
Kubilay Uzun-Captain, Turkish Air Force
B.S., Turkish Air Force Academy, 1993
Master of Science in Systems Engineering-September 2004
Master of Science in Electrical Engineering-September 2004
Advisors: Phillip E. Pace, Department of Electrical and Computer Engineering
Murali Tummala, Department of Electrical and Computer Engineering

The objective of this thesis is to investigate the requirements and limitations of boost phase ballistic missile intercept systems that contain an interceptor and its guidance sensors (both radar and infrared). A three-dimensional computer model is developed for a multi-stage target with a boost phase acceleration profile that depends on total mass, propellant mass and the specific impulse in the gravity field. The radar cross-section and infrared radiation of the target structure are estimated as a function of the flight profile. The interceptor is a multi-stage missile that uses fused target location data provided by two ground-based radar sensors and two low earth orbit infrared sensors. Interceptor requirements and limitations are derived as a function of its initial position from the target launch point and the launch delay. Sensor requirements are also examined as a function of the signal-to-noise ratio during the target flight. Electronic attack considerations within the boost phase are also addressed, including the use of decoys and noise jamming techniques. The significance of this investigation is that the system components within a complex boost phase intercept scenario can be quantified and requirements for the sensors can be numerically derived.

EFFECTS OF METOC FACTORS ON EW SYSTEMS AGAINST LOW DETECTABLE TARGETS IN A TROPICAL LITTORAL ENVIRONMENT

Jorge V. Vazquez Zarate-Lieutenant Commander, Mexican Navy
B.S., Mexican Naval School, 1990
Master of Science in Systems Engineering (EW)-September 2004
Advisor: Kenneth L. Davidson, Department of Meteorology
Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

In littoral warfare (LW), naval operations face a whole new range of missions and types of threats. In such situations, Electronic Warfare (EW) systems are extremely important, yet constantly challenged to perform faster and more accurate detection and recognition of potential threats. However, meteorological and oceanographic (METOC) factors can severely modify the effectiveness of EW systems, particularly against low detectable targets in warm waters.

Therefore, this thesis analyzes the effects of tropical littoral environments in the expected performance of generic RF and IR systems when used under tropical scenarios. It analyzes the outputs of propagation models included in the software suites Advanced Refractive Environment Prediction System (AREPS) and Tactical Acquisition of Weapons Systems (TAWS) when using actual data from different sources in the Yucatan Channel.

The results of this study demonstrate how radically the environmental conditions can change, clearly modifying the efficiency of surveillance and detection systems in shipborne platforms. Further, several issues related to the need of valuable data and additional research are addressed, while providing useful insights to operational commanders and decision makers for the use of EW systems and available Tactical Decision Aids (TDAs) at the typical scenarios of littoral warfare in tropical waters.

KEYWORDS: Littoral Warfare, Tactical Decision Aids, Radar, IR, TAWS, AREPS, Refractivity, Propagation, Attenuation, ESM, EW, Probability of Detection, Performance
Surgical technicians at Naval hospitals provide a host of services related to surgical procedures, including handing instruments to surgeons, assisting operating room nurses, prepping and cleaning operating rooms and administrative duties. At the Naval Medical Center San Diego (NMCSD), there are 83 surgical technicians that must be scheduled for these duties. The three military and one civilian hospital interviewed for this thesis manually schedule these duties. Weaknesses in the manual scheduling process exposed during interviews at these hospitals include assignment inequities and the time needed to create the manual schedule. This thesis reports on an optimization-based and spreadsheet-implemented tool developed to schedule surgical technicians for both daily and weekly duties at a Naval hospital. The tool is demonstrated for the surgical technician department at NMCSD. The schedulers at NMCSD verify the utility of the developed tool and cite a drastic reduction in the time required to generate timely, equitable, and accurate schedules. The study also investigates historical operating room usage data and makes suggestions for improving scheduling practices based on these data.

KEYWORDS: Optimization, Integer Programming, Scheduling, Transportation Model
MASTER OF ARTS

National Security Affairs
Security Studies
DON’T ASK, DON’T TELL: A COSTLY AND WASTEFUL POLICY
Johnny L. Barnes, II-Major, United States Air Force
B.S., United States Air Force Academy, 1991
Master of Arts in National Security Affairs-September 2004
Advisor: Jeffrey W. Knopf, Department of National Security Affairs
Second Reader: Jon Czarnecki, Naval War College

Since the current “Don’t Ask, Don’t Tell” policy was adopted in the early 1990s, several changes have taken place which call into question the policy’s validity. First, the argument used by proponents of the ban, namely that cohesion would suffer if admitted homosexuals were allowed to serve, has been undercut by social science analyses on the correlation between cohesion and performance. Second, this argument has been undercut by empirical evidence from several nations that have lifted all restrictions on homosexual service, yet have suffered no decrease in cohesion or performance, despite the reticence of their respective militaries to lift the bans. At the same time, the U.S. public has moved toward a greater acceptance of the notion of admitted homosexuals serving in the military, evidenced by a December 2003 Gallup Poll showing 79% approving, including 91% of all Americans age 18-29. Evidence also indicates that the current policy costs at least $40 million per year, just to replace those who have been discharged due to their sexual orientation. Other costs include wasted human resources at a time of critical shortfalls in many specialties essential to the ongoing Global War on Terror, and the immeasurable cost of sanctioned, unjustifiable discrimination by the U.S. Government. The time to lift all restrictions on homosexual service in the U.S. Armed Forces has come.

KEYWORDS: Gays/Lesbians in the Military, Homosexuals, Personnel Policy, Civil Rights, Australia, Great Britain, Canada, Israel, United States, Cohesion, Cost of the Gay Ban

CARROTS OR STICKS?: LIBYA AND U.S. EFFORTS TO INFLUENCE ROGUE STATES
Jamie A. Calabrese-Lieutenant, United States Navy
B.A., Wake Forest University, 1996
Master of Arts in National Security Affairs-September 2004
Advisor: Jeffrey W. Knopf, Department of National Security Affairs
Second Reader: James A. Russell, Department of National Security Affairs

Dramatic changes in the international system since the early nineties, namely the end of the Cold War and the post-9/11 ascendancy of the Bush Doctrine, have left many wondering whether Cold War era influence strategies such as deterrence, compellence, and engagement are viable against new U.S. threats such as rogue states. This thesis examines U.S. efforts between 1986 and 2004 to convince Libya to cease its support for international terrorism and weapons of mass destruction (WMD). U.S. influence strategy towards Libya was a short term failure and a long term success. The compellence and deterrence policies established by President Reagan and strengthened by later administrations served to isolate Libya economically and diplomatically and set the conditions for successful conditional engagement. Positive behavior change by Libya began first with the Clinton Administration’s introduction of conditional engagement. The Bush Administration, benefiting from years of Libyan isolation and the positive response to conditional engagement, continued to engage Libya in an incremental fashion. Libya renounced its terrorist ties in August 2003 and weapons of mass destruction in December 2003. Since then, Tripoli has taken actionable steps to verify this change of policy and both governments are currently on course for reconciliation.
COLOMBIA’S RESURRECTION: ALTERNATIVE DEVELOPMENT IS THE KEY TO DEMOCRATIC SECURITY

Adam L. Fleming - Lieutenant, United States Navy
B.S., United States Naval Academy, 1998
Master of Arts in National Security Affairs—September 2004
Advisors: Thomas C. Bruneau, Department of National Security Affairs
Jeanne K. Giraldo, Department of National Security Affairs

This thesis examines the role of alternative development in the Colombian and U.S. governments’ counter drug strategies. Both governments include alternative development as a part of their policies, but provide limited funding to the programs when compared to the funding for forced eradication and security measures. Existing policies have produced reductions in drug cultivation in many areas and the Colombian government has made gains in security throughout the country, particularly the remote rural regions. These gains make conditions in Colombia suitable for large-scale alternative development supported by increased funding. Both governments are addressing components of successful alternative development programs, but funding disparities are hindering the effectiveness of the programs. While the international and European communities are staunch supporters of alternative development, the funding they provide has been limited in scope because of disagreement with the U.S.-backed eradication policies. The U.S. and Colombian governments, in conjunction with the international community, must focus more on alternative development in order to consolidate the recent gains in democratic security.

KEYWORDS: Alternative Development, Colombia, Crop Substitution

EUROS, POUNDS, AND ALBION AT ARMS: EUROPEAN MONETARY POLICY AND BRITISH DEFENCE IN THE 21ST CENTURY

Timothy W. Fox-Lieutenant, United States Navy
B.S., United States Naval Academy, 1997
Master of Arts in National Security Affairs—September 2004
Advisor: Donald Abenheim, Department of National Security Affairs
Second Reader: Warwick Boulton, Naval War College

The membership of the United Kingdom in the European Monetary Union (EMU) is a central issue of contemporary British foreign policy. The question of membership has profound implications for the development of the European Union (EU), the future of the North Atlantic Treaty Organization (NATO) and potentially upon the much vaunted Anglo-American “special relationship.” On a practical level, excluding the political implications of membership, joining the EMU means surrendering the pound sterling for the euro and, in doing so, the British would also surrender control of monetary policy. This thesis examines the historical links between British defence and monetary policy and argues that there are strong historical bonds linking the two in the political psychology of Britain. This link has created for Britain twin nationalistic icons in the pound and the military. This thesis illustrates that a paradox exists in that membership in the EMU would improve British defence spending and yet nationalistic forces resist membership. At the same time, forces in Britain in favor of monetary integration, unable to accomplish it but pressured to show they are dedicated to the project of European integration, paradoxically commit to further defence integration through the Common Foreign and Security Policy of the EU.

KEYWORDS: United Kingdom, Great Britain, European Union, European Monetary Union, Pound Sterling, Euro, Defence Policy, Defence Industry, Monetary Policy
NORTH KOREA: THE REALITY OF A ROGUE STATE IN THE INTERNATIONAL ORDER
Michael F. Ginty-First Lieutenant, United States Air Force
B.A., Boston College, 2001
Master of Arts in National Security Affairs-September 2004
Advisors: Anne L. Clunan, Department of National Security Affairs
Edward A. Olsen, Department of National Security Affairs

This thesis examines what it means to be a rogue state in a world in which the international order is becoming increasingly interdependent. The last two U.S. administrations as well as the other major powers label the Democratic People's Republic of Korea (DPRK) as a pariah state exhibiting rogue behavior. This thesis analyzes the varied and competing views of the international order and measures how North Korea does or does not fit the parameters of what it means to be a normal state. Since its creation in 1948, North Korea has pursued policies of limited engagement, heavily influenced by an ideology that markedly contradicts the commonly accepted values and principles of the majority of the states in the international system. After the Cold War, the DPRK has further alienated the other players in the system with continued proliferation attempts as well as brinkmanship negotiating behavior. In order for the current Six Party Talks to be successful, the major powers involved need to understand the perspective with which North Korea views the international order.

KEYWORDS: North Korea, Six Party Talks, International Community, Realism, Complex Interdependence

JAPANESE DEFENSE POLICY: LEGACIES OF THE PAST, CHALLENGES FOR THE FUTURE
Kenneth L. Jipping-Lieutenant, United States Navy
B.A., Chapman University, 1996
Master of Arts in National Security Affairs-September 2004
Advisor: Douglas Porch, Department of National Security Affairs
Second Reader: Edward A. Olsen, Department of National Security Affairs

Japan faces new security challenges due to the rise of China, the potential nuclearization of the Korean Peninsula, and the distraction of the United States forces caused by the “War on Terror.” This will mean that, increasingly, Japan must take care of its own defense requirements. Unfortunately, this will not be an easy transition for a country with a past of militarism and colonial expansion, an aversion to nuclear weapons, and a political structure that has purposely limited the role and resources of the Japanese Self-Defense Forces (JSDF). This thesis examines the legacies of the past-militarism, colonialism, the aversion to nuclear weapons, and the political structure that emerged after 1945, and assesses how those legacies impact the adaptation of the JSDF to the new security requirements of the 21st Century. The conclusion is that Japan must emerge from under the security umbrella of the United States and become a military power commensurate with its economic power.

KEYWORDS: Japan, JSDF, Militarism, Imperialism

RUMORS IN IRAQ: A GUIDE TO WINNING HEARTS AND MINDS
Stephanie R. Kelley-Captain, United States Air Force
B.S., University of Maryland, 1996
Master of Arts in National Security Affairs-September 2004
Advisors: James A. Russell, Department of National Security Affairs
Karen Guttieri, Department of National Security Affairs

This thesis proposes the study of rumor as a guide to the battle for hearts and minds in Iraq. Existing rumor theory is reviewed to identify how rumors function and what can be learned from them. Rumors often serve as a window into a community, and can provide valuable information for developing a campaign to assess, monitor, and gain the support necessary to defeat insurgents. This thesis employs two distinct
typologies to analyze more than ten months of rumors in Baghdad, Iraq. The motivation typology provides indications of Iraqi sentiment, and suggests that unrelieved anxiety and fear is likely contributing to widespread hostility towards the U.S.-led coalition. Indications of unrealistic expectations are also evident, potentially contributing to hostility levels as those expectations go unrealized. The subject typology identifies major concerns of the Iraqi people and suggests that specific fears are inhibiting cooperation with U.S. counterinsurgency efforts. This thesis then examines rumor remedies. Because rumors rely on effective communication skills, American and Arab cultural communication styles are contrasted and integrated into tailored remedies for disseminating U.S. intentions and shaping the Iraqi perspective. The findings in this thesis could assist coalition information campaigns by alerting the coalition to existing Iraqi perceptions, so that messages can be tailored to address significant concerns and fears.

KEYWORDS: Rumor, Communication, Culture, Iraq, Arab, Middle East, Hearts and Minds, Counterinsurgency, Insurgency, Intelligence, Information Operations, Psychological Operations, Public Affairs

UNIFICATION STRATEGY FOR NORTH AND SOUTH KOREA: THE MOST PRUDENT U.S. POLICY OPTION TO SOLVE THE NORTH KOREAN NUCLEAR CRISIS
Hyon K. David Lee-Major, United States Air Force
B.S., University of Southern California, 1989
M.B.A., University of Southern California, 1994
Master of Arts in National Security Affairs-September 2004
Advisor: Edward A. Olsen, Department of National Security Affairs
Second Reader: Gaye Christoffersen, Department of National Security Affairs

The North Korean nuclear weapons issue reached a dangerous impasse in the last eighteen months as North Korea continues to resist international pressure to halt its nuclear weapons and missile programs. North Korea watchers and nuclear experts estimate that North Korea could currently have up to six or seven plutonium-based nuclear bombs. Indeed, North Korea announced to the world in October 2003 that they now have the capability of “nuclear deterrence.” International parties would agree that a nuclear North Korea will have grave consequences on the Korean Peninsula and the East Asia region.

Accordingly, this thesis contends that the Bush Administration miscalculated in its policy on North Korea by allowing a hard-line ideology to cloud its better judgment on the most feasible and prudent policy vis-à-vis North Korea. Given the events in the last year or so, this thesis makes the assumption that North Korea already possesses nuclear weapons. Indeed, the CIA has made formal statements saying that North Korea, in essence, already possesses nuclear weapons. The intelligence service believes that conventional explosives tests, conducted since the 1980s, have allowed the North Koreans to verify that their nuclear designs would work. The agency believes North Korea has one or two nuclear weapons similar to that dropped on Hiroshima by the United States during World War II.

Given these circumstances and the policy options available to the Bush administration, the best course of action is to adopt a policy of unifying the two Koreas. The argument is that a reunified Korea -- united diplomatically with the U.S. leading the way in a multilateral forum -- would satisfy most, if not all, U.S. interests by: 1) resolving, once and for all, the North Korean nuclear problem; 2) eliminating the possibility of another Korean war; 3) neutralizing or even weakening China’s growing influence over South Korea and East Asia; 4) strengthening the United States’ role and influence on the Korea peninsula and the region; 5) eliminating Japan’s primary security threat and paving the way for a stronger alliance between the U.S., a united Korea, and Japan; and 6) fulfilling the obligation to unify the two Koreas after almost sixty years of illegitimate separation. In essence, it is in the best interest of the United States (including both strategic and values-based interests) to reunify the two Koreas.

KEYWORDS: North Korea, South Korea, Korean Peninsula, Korean Unification, Korean Reunification, Nuclear Proliferation, U.S. Policy, Northeast Asia Security
THE DOMESTIC AND INTERNATIONAL DIMENSIONS OF RISK: PROSPECT THEORY AND ARGENTINA

Jason B. McClure-Second Lieutenant, United States Air Force
B.S., United States Air Force Academy, 2003
Master of Arts in National Security Affairs-September 2004
Advisors: Maria Rasmussen, Department of National Security Affairs
Harold A. Trinkunas, Department of National Security Affairs

For years, contemporary analysts have stated that Argentine foreign policy has followed incoherent patterns, oscillating between open support and defiance of the U.S. on a variety of different issues, regardless of regime. Only in the 1990s, under the presidency of Carlos Menem, did Argentina begin following an apparently consistent foreign policy. The claim of inconsistency seems to be rooted in rational-choice decision theory, expecting that policy-makers should make policy choices based on perceptions of absolute utility. However, analyzing Argentine foreign policy from a historical perspective using a relatively new theory yields interesting results and points to general consistency in the nation’s projection of itself.

Prospect theory is a decision-making theory that claims decision makers make choices in terms of relative rather than absolute utility, based on a status-quo reference point. Based on this theory, individuals are likely to take risks when facing losses and avoid risk facing games. Traditionally applied at one level of analysis, this thesis applies prospect theory across both the domestic and international levels, examining how losses or gains at one level can affect decisions made at the other and vice versa. By applying prospect theory as a two level game, Argentine foreign policy appears to be based on its fall from “grace” throughout the twentieth century.

KEYWORDS: Prospect Theory, Two-level Game, Argentina, Foreign Policy, Risk, Perón, Galtieri, Menem

THUMPING THE HIVE: RUSSIAN NEOCORTICAL WARFARE IN CHECHNYA

Scott E. McIntosh-Captain, United States Air Force
B.A., University of Kansas, 1993
Master of Science in National Security Affairs-September 2004
Advisor: Mikhail Tsypkin, Department of National Security Affairs
Second Reader: Timothy Thomas, Foreign Military Studies Office

Since the 1994 Chechen War, analysts have written volumes about the evolution of and lessons learned from this ongoing conflict. Why has success eluded this Cold War superpower in subduing the small Caucasian republic? Russia has since hiccuped back and forth across the spectrum of conflict in the region and the years have provided much speculation as to why. For a decade, researchers have described Chechen terror, erosion of the Russian military, and the inconsistent resolve of the Russian population to support the Kremlin’s actions. These are significant independent variables that might explain Russian failure in 1994. However, another less tangible factor, Richard Szafranski’s paradigm of Neocortical Warfare, may explain Russia’s poor performance in the initial invasion and their improved performance in 1999. To evaluate this concept, the author examines the influences of intelligence preparation of the battlespace, public affairs, psychological operations, and battlefield communications—prime factors in influencing combatants’ perceptions—to gauge the effects of these factors on the relative Russian performances in the separate invasions. The author then holds the results up to the Neocortical lens to evaluate whether the concept is pertinent to the ongoing conflict in Chechnya.

KEYWORDS: Chechnya, Grozny, Information Warfare, Intelligence Preparation of the Battlespace, Public Affairs, Psychological Operations, Battlefield Communications, Neocortical Warfare
NAVY AND MARINE CORPS INTELLIGENCE INTEGRATION
Jon A. O’Connor-Lieutenant, United States Navy
B.A., Roanoke College, 1994
Master of Arts in National Security Affairs-September 2004
Advisor: CAPT Steven B. Ashby, USN, Department of National Security Affairs
Second Reader: Robert Simeral, Department of National Security Affairs

This thesis contends that Navy and Marine Corps Intelligence would be more effective in the Global War on Terrorism if they were more integrated. Navy and Marine Corps Intelligence integration should bring Sailors and Marines together in all aspects of warfare to conduct coordinated intelligence.

This does not imply that Sailors and Marines should be unified into one force. In fact, it is the unique skills of each service that make them indispensable to the other. Naval Intelligence provides the large scale team of professionals, robust onboard systems, communications, and the air intelligence/targeteering expertise. The Marine Corps provides detailed human intelligence in austere, anti-access environments. Designed for highly accurate targeting and raids ashore, Marine Corps intelligence can provide the timely, accurate, and relevant intelligence needed to fight the Global War on Terrorism for Expeditionary Strike Groups, Carrier Strike Groups, and even Surface Action Groups.

The Naval Operating Concept for Joint Operations calls for further integration from both the Navy and the Marine Corps. As Sea Power 21 and Marine Corps Strategy 21 merge into Naval Power 21, the need for further Navy and Marine Corps integration becomes clear. This will challenge current organizational mindsets. Nevertheless, sea based Sailors and Marines must be able to operate side by side seamlessly in order to be victorious in the Global War on Terrorism.

KEYWORDS: Naval Intelligence, Marine Corps Intelligence, Intelligence Policy, Navy and Marine Corps Integration, Global War on Terrorism, Sea Basing, FORCEnet, Naval Operating Concepts, Human Intelligence

RUSSIA’S INTERESTS IN THE GLOBAL WAR ON TERRORISM: IMPLICATIONS FOR A CONTINUING U.S.-RUSSIAN PARTNERSHIP
Jennifer L. Petykowski-Captain, United States Air Force
B.S., United States Air Force Academy, 1998
Master of Arts in National Security Affairs-September 2004
Advisors: Anne L. Clunan, Department of National Security Affairs
Mikhail Tsypkin, Department of National Security Affairs

The September 11th terrorist attacks triggered an unexpected rapprochement between the United States and the Russian Federation. Russia joined the U.S.-led coalition and supported Operation Enduring Freedom. U.S.-Russian collaboration in Afghanistan surpassed most previous efforts in terms of the level of cooperation attained, especially in traditionally inviolable areas such as intelligence-sharing; however, disagreements over the invasion of Iraq confirmed that the U.S. and Russia have not yet achieved a strategic partnership. This study uses Russia’s decisions during the War on Terrorism to discover the motives driving Russian foreign policy. Analysts offer three dominant rationales regarding Russia’s behavior: 1) the desire to balance U.S. unilateralism, 2) to gain support for “anti-terrorist” action in Chechnya, or 3) to advance the nation’s economic interests. Each variable is individually assessed to see if expected gains in that sphere covary with Russia’s decision to support and if potential losses correlate with Russia’s decision to oppose the War on Terrorism. The study also reveals the true nature of the U.S.-Russian relationship and exposes challenges and future possibilities for U.S.-Russian relations. The last section makes policy recommendations and suggests how to build a stronger U.S.-Russian partnership.

KEYWORDS: Terrorism, Russia, Foreign Policy, U.S. Foreign Policy, Global War on Terrorism
FROM BOSNIA TO BAGHDAD: THE EVOLUTION OF U.S. ARMY SPECIAL FORCES FROM 1995 TO 2004
Armando J. Ramirez-Major, United States Army
B.A., Western Michigan University, 1991
Master of Arts in National Security Affairs-September 2004
Advisor: Daniel Moran, Department of National Security Affairs
Second Reader: Peter J. Gustaitis, Department of Defense Analysis

This thesis presents a historical analysis of the evolution of U.S. Army Special Forces operations from 1995 to 2004, focusing specifically on operations conducted in the Balkans (Bosnia and Kosovo), Afghanistan, Iraq, and answering the question: How have the operations conducted by U.S. Army Special Forces evolved from the Balkans in 1995 through Operation Enduring Freedom (OEF) to Operation Iraqi Freedom (OIF)?

The thesis examines the progression of Special Forces operations during each of the aforementioned campaigns, analyzing their evolution in the areas of intelligence operations, unconventional warfare, foreign internal defense, close air support, integration with conventional forces, and the institutionalization of lessons learned. The thesis concludes by examining future roles of U.S. Army Special Forces with respect to employment.

Tracing the progression of Special Forces employment from the Balkans to OIF is critical to understanding the factors contributing to the success of Special Forces operations in both the decisive operations and stability and support (SASO) phases of OEF and OIF.

KEYWORDS: U.S. Army Special Forces, Special Forces in Balkans, Special Forces in Afghanistan, Special Forces in Iraq, Special Forces Evolution, Special Forces Operations, Unconventional Warfare

PATH DEPENDENCE AND FOREIGN POLICY: A CASE STUDY OF UNITED STATES POLICY TOWARD LEBANON
Raymond L. Reyes-Major, United States Air Force
B.A., University of Maryland, 1990
M.P.A., Troy State University, 1993
M.B.A., Webster University, 1999
Master of Arts in National Security Affairs-September 2004
Advisor: Anne Marie Baylouny, Department of National Security Affairs
Second Reader: James A. Russell, Department of National Security Affairs

Currently, the U.S. seems to be focused solely on achieving success in the liberation of Iraq and the establishment of a working democracy there. What has often been overlooked is the historical legacy of a tiny nation in the Levant, Lebanon. Many studies show Lebanon as a viable democracy prior to the start of the civil war in 1975. Today, the infrastructure and the institutions for successfully transitioning back to democracy are still present. Among the Arab states, Lebanon is the most likely to succeed in transitioning to democracy. Considering the U.S. national security strategy of propagating democracy and free enterprise, it would be vital to U.S. national security interests to consider Lebanon. Successfully supporting a return to democracy in Lebanon would not only lessen its appeal as a haven for terrorism, but would also provide the U.S. with a democratic Arab ally in the Middle East.

This case study identifies path dependence as a significant factor behind the U.S. policy of disengagement toward Lebanon since 1983. It argues that instead of the vicious cycle of disengagement wrought by the 1980s policy, a new path of engaged political activism could bring a more positive future for Lebanon.

KEYWORDS: Path Dependence, U.S. Policy, Lebanon, Democracy, Middle East
RETURN WITH HONOR: CODE OF CONDUCT TRAINING IN THE NATIONAL MILITARY STRATEGY SECURITY ENVIRONMENT
Laura M. Ryan-Major, United States Air Force
B.A., University of Michigan, 1991
Master of Strategic Intelligence, American Military University, 2003
Master of Arts in National Security Affairs-September 2004
Advisor: Col Joe E. Tyner, USAF, Department of Defense Analysis
Second Reader: CAPT Steven B. Ashby, USN, Department of National Security Affairs

As the United States transforms from threat-based to capabilities-based combat operations, one must examine the ability of existing international laws, domestic directives, and Service regulations and training programs to protect American military and civilian prisoners of war, detainees and hostages while under enemy control. This thesis explores the impact of the National Military Strategy of the United States of America 2004 (NMS) security environment on existing Code of Conduct (CoC) training. A thorough examination and comparison of the existing legal framework to the future components of warfare provides a new context through which to evaluate existing CoC training programs and determine the overall applicability of the course content to the expanded spectrum of captivity. The Department of Defense must compensate for the lack of effective international protection by designing a conduct-after-capture program that addresses the rapidly changing conditions of different captivity situations. This thesis reveals that the existing CoC training programs and survival, evasion, resistance and escape (SERE) skill sets lack the flexibility needed to enable the isolated person to rapidly adjust to changes in the future captivity environment, and proposes a core captivity curriculum that provides an adaptable set of skills designed to enable the captive to survive and return with honor regardless of the captor or location of captivity.


U.S. AND RUSSIAN COOPERATION AGAINST NUCLEAR PROLIFERATION
Samuel R. Shearer-Captain, United States Air Force
B.S., University of Utah, 1996
M.S., Troy State University, 2003
Master of Arts in National Security Affairs-September 2004
Advisors: Peter R. Lavoy, Department of National Security Affairs
Mikhail Tsypkin, Department of National Security Affairs

Iran may have a nuclear weapon soon if Washington and Moscow do not unite to slow its efforts. The collapse of the Soviet Union created new complications in a long tradition of nonproliferation cooperation between the United States and Russia, and Iran is just one example. In the 1960s, faced with the common nuclear threat of China, Washington and Moscow united to negotiate the Limited Test Ban Treaty and Nuclear Nonproliferation Treaty to prevent China and other nuclear aspirants from proliferating nuclear weapons. The U.S. and Russia shepherded their allies to the nonproliferation table and made them sign the treaties. Their efforts retarded nuclear proliferation but failed to prevent China, India, and Pakistan, from gaining nuclear weapons. Following the Cold War, their cooperative relationship changed as Washington began treating Moscow as an unequal partner and their nonproliferation efforts broke down into a cooperative and uncooperative mix. This mix has reduced the effectiveness of their efforts and may accelerate proliferation. The September 11th terrorist attacks focused attention on the nuclear proliferation threat to the international community. If this threat is to be minimized, Washington and Moscow must work together, as they did against China, to prevent new nuclear powers from emerging.

KEYWORDS: Nuclear Nonproliferation, Nonproliferation, Cooperation, Cooperative Threat Reduction, Nonproliferation History, United States and Russia, Weapons of Mass Destruction, Preemption, Preemptive, Proliferation, Proliferation Security Initiative, Arms Control, Arms Control Treaties, Nuclear Nonproliferation Treaty, NPT, LTBT
TRANSFORMATION IN THE DEVELOPING WORLD: AN ANALYSIS OF COLOMBIA’S SECURITY TRANSFORMATION
Darren D. Sprunk-Major, United States Air Force
B.A., Montana State University, 1988
M.A., Embry-Riddle Aeronautical University, 1996
Master of Arts in National Security Affairs-September 2004
Advisor: Jeanne K. Giraldo, Department of National Security Affairs
Second Reader: Harold A. Trinkunas, Department of National Security Affairs

This thesis examines security force transformation issues germane to developing countries in their attempts to counter emerging threats of international terrorism, insurgency, WMD proliferation, and organized crime. Colombia’s recent and apparently successful transformation process serves as the case study. This project concludes that the intelligence-based, rapid deployment force (IBRDF) model implemented has contributed significantly to reducing the threat from illegally armed groups (IAGs).

Three distinct periods, military status quo and near defeat (pre-1998), adaptation under President Andres Pastrana (1998-to-2002), and true transformation under President Alvaro Uribe (2002-to-present), were assessed to determine how transformation occurred and to identify the principle engine behind the change. Although U.S. support for civilian leadership and training of officers facilitated the process, transformation was financed almost entirely by the Colombian government.

Overall, research highlights four lessons with broader applicability for other nations: the critical role of civilian leadership; the benefit of existing core competency, the importance of an obedient military leadership that either actively supports the reform or at least acquiesces to it, and the usefulness of foreign assistance in the form of education and training. Corruption and the challenges of police-military cooperation are likely obstacles to the transformation process in developing countries.

KEYWORDS: Colombia, Transformation, Intelligence-based, Rapid Deployment Force, IBRDF, Terrorism, Insurgency, Revolutionary Armed Forces of Colombia, Fuerzas Armadas Revolucionarios de Colombia, FARC, National Liberation Army, ELN, Paramilitary, United Self-Defense Forces of Colombia, Autodefensas Unidas de Colombia, AUC, Fuerza de Despliegue Rapido, FUDRA, Uribe, Colombian Military, COLMIL, Colombian National Police, CNP

THE JUSTICE OF PREVENTATIVE WAR
Henry A. Stephenson-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1995
Master of Arts in National Security Affairs-September 2004
Advisor: Daniel Moran, Department of National Security Affairs
Second Reader: CAPT Steven B. Ashby, USN, Department of National Security Affairs

In response to the 9/11 attacks and continuing threats of mass-casualty terrorism, the United States has adopted a new security strategy that emphasizes anticipatory actions, including preventive war. Prevention, undertaken in the absence of an act of aggression or an imminent threat, is prohibited by modern concepts of just of war and international law. Many critics of the strategy fear that any legitimization of preventive war would endanger international stability. But an examination of the relevant ethical issues from the perspective of “just” war doctrine reveals contradictions within a blanket prohibition of preventive war. Preventive “strategic interventions” against illiberal regimes-states that correlate with the threats of terrorism and weapons of mass destruction parallel humanitarian interventions in that they have an ethical basis in the relationship between human rights and the right of state sovereignty. A widely-accepted minimum standard of human rights, incorporated into new international institutions and/or an explicit revision of the definition of “just” war, could serve as an ethical boundary for both preventive wars and humanitarian interventions. The formal qualification of prevention and its merger with humanitarian goals could bring enhanced international legitimacy and support to preventive actions by the United States and its allies.

KEYWORDS: Just War, Jus ad Bellum, Preemptive War, Preemption, Preventive War, Prevention, War on Terrorism, National Security Strategy, Strategic Intervention, Humanitarian Intervention, Human Rights
France opposed the U.S.-led intervention in Iraq in March 2003 while Italy supported it. Domestic dynamics, including popular opinion and growing concern for Muslim sentiment, exerted a secondary influence on those decisions. Other factors that influenced the leaders of France and Italy to take opposing stances on the prospective intervention included security and threat assessments. Discord in U.S.-French relations was exacerbated by disagreements over other international issues, especially the role of the United Nations Security Council. This thesis assesses the relative weight of the various factors in the French and Italian decisions, and examines the interplay of the key national decisions about intervention in Iraq made by American, French, and Italian leaders. The thesis concludes that French and Italian decisions were influenced by other factors in addition to the primary issues of Iraqi compliance with the UN Security Council resolutions calling for the elimination of weapons of mass destruction and certain delivery means and whether the use of force was an appropriate and justified course of action in the event of non-compliance. The thesis also concludes that the severe damage to U.S.-French relations may be overcome as Paris and Washington cooperate in meeting international security responsibilities. The European Union’s Common Foreign and Security Policy may face greater challenges, stemming from the significant intra-EU differences revealed during the Iraq crisis.

KEYWORDS: France, Italy, Iraq, Weapons of Mass Destruction, WMD, Al-Qaeda, NATO, UN Security Council

ISRAEL’S ATTACK ON OSIRAK: A MODEL FOR FUTURE PREVENTIVE STRIKES?
Peter S. Ford-Major, United States Air Force
B.S., United States Air Force Academy, 1990
Master of Arts in Security Studies (Defense Decision-Making and Planning)-September 2004
Advisor: Peter R. Lavoy, Department of National Security Affairs
Second Reader: James J. Wirtz, Department of National Security Affairs

Twenty-three years ago, Israeli fighter pilots destroyed the Osiraq nuclear reactor and made a profound statement about global nuclear proliferation. In light of the recent preventive regime change in Iraq, a review of this strike reveals timely lessons for future counterproliferation actions. Using old, new, and primary source evidence, this thesis examines Osiraq for lessons learned from a preventive attack on a non-conventional target. Before attacking Osiraq, Israeli policymakers attempted diplomatic coercion to delay Iraq’s nuclear development. Concurrent with diplomatic actions, Israeli planners developed a state of the art military plan to destroy Osiraq. Finally, Israeli leaders weathered the international storm after the strike. This thesis examines Israeli decision making for each of these phases and draws two conclusions. First, preventive strikes are valuable primarily for two purposes: buying time and gaining international attention. Second, the strike provided a one-time benefit for Israel. Subsequent strikes will be less effective due to dispersed and hardened nuclear targets and limited intelligence.

KEYWORDS: Osiraq, Israel, Begin Doctrine, Iraq, Counterproliferation, Proliferation, Preventive Strike, Middle East WMD, WMD, Middle East Conflict
POLITICAL EXCLUSION AND VIOLENCE: THE ISLAMIST MOVEMENT IN EGYPT
Paul A. Gallaher-Major, United States Air Force
B.A., Concordia College, 1989
M.A.S., Embry-Riddle Aeronautical University, 2003
Master of Arts in Security Studies-2004
Advisor: Anne Marie Baylouny, Department of National Security Affairs
Second Reader: Seyyed Vali Reza Nasr, Department of National Security Affairs

Since the early 20th century, persons across the Muslim world have attempted to move their society toward a more religious Islamic path. They have attempted to form political parties and participate in elections, only to be marginalized and repressed. Some have reacted violently, carrying out attacks against government officials and other targets. Typically, a cycle of violence, repression and political exclusion transpires. Democratic reform is not uncomplicated. Both practical and moral considerations demand changes in the policies of both the United States and Egypt. The Egyptian government’s electoral engineering and interference does not go unnoticed by the world and undermines the legitimacy of the government to its own citizens and the world community alike. Co-opting moderate Islamists may seem threatening to President Mubarak as well as to Western countries whose citizens continue to embrace Orientalist ideas. This study maintains that when moderate Islamists are allowed to participate in politics, they will restrain their stances regarding strict interpretations of Islam, as have the New Islamists in Egypt. The alternative is the status quo, which is both immoral in terms of personal liberty and unworkable for those desiring stability in the Middle East.

KEYWORDS: Political Islam, Egypt, Islamist, Democracy, Repression, Reform, Terrorism, Muslim, Violence, Authoritarian, Muslim Brotherhood, Islam, Mubarak, Sadat, Nasser

INTELLIGENCE AND HIGH INTENSITY DRUG TRAFFICKING AREAS (HIDTA): A CRITICAL EVALUATION OF THE HIDTA INVESTIGATIVE SUPPORT CENTER (ISC)
Michael J. Gutierrez-Captain, United States Army, New Mexico Army National Guard
B.A., University of New Mexico, 1993
M.P.A., University of New Mexico, 1998
Master of Arts in Security Studies (Civil Military Relations)-September 2004
Advisors: Jeanne K. Giraldo, Department of National Security Affairs
Harold A. Trinkunas, Department of National Security Affairs

The purpose of this thesis is to critically evaluate the ongoing reform of the High Intensity Drug Trafficking Area (HIDTA) Investigative Support Center (ISC). Prior to 9/11, the national intelligence apparatus was littered with flaws, including lack of information sharing, interagency conflict, and autonomous operations. The HIDTA Intelligence Support Center in New Mexico was no exception. Post 9/11, many national agencies realized that in order to successfully address the increasing threat of terror, several changes needed to be made in all levels of the intelligence system. Similarly, the HIDTA Investigative Support Center has reacted to the post 9/11 environment by more strictly enforcing its framework for information-sharing and instituting a series of changes in its institutional processes. This process of reform has yielded positive results for the New Mexico HIDTA ISC. The ISC has now transformed into the centerpiece of information exchange and interagency cooperation among HIDTA members. The ISC is also acting as a conduit or “Fusion Center” for information sharing between agencies investigating crimes relating to drug trafficking, terrorism and money laundering.

SECURITY STUDIES

THE ARMY BEFORE LAST: MILITARY TRANSFORMATION AND THE IMPACT OF NUCLEAR WEAPONS ON THE U.S. ARMY IN THE EARLY COLD WAR
Bret C. Kinman-Major, United States Army
B.A., North Georgia College, 1991
Master of Arts in Security Studies (Defense Decision-Making and Planning)-September 2004
Advisor: Daniel Moran, Department of National Security Affairs
Second Reader: Richard Hoffman, Center for Civil-Military Relations

This thesis analyzes the impact of nuclear weapons on the doctrine and force structure of the U.S. Army during the early Cold War (1947-1957). This impact on the U.S. Army is compared with the impact on the U.S. Air Force and Navy during that time. Nuclear weapons brought a new aspect to warfare. Their unprecedented economy of destructive power changed the way nations viewed warfare. For the Army, nuclear weapons presented a dual challenge. The Army faced a U.S. security policy centered on the massive use of these weapons; the Army also struggled to understand how these weapons would be utilized on the battlefield. The nation’s security policy of large scale strategic nuclear bombardment of the Soviet Union favored the Air Force and to a lesser degree the Navy. The Army viewed this policy as single minded, purposely limiting the nation’s options to all out nuclear war or deference to another national will. Throughout this period, the Army faced an internal struggle to incorporate these weapons and an external struggle to retain a useful position within the U.S. defense establishment.

KEYWORDS: U.S. Army, Early Cold War, Nuclear Weapons

NATIONAL SECURITY TO NATIONALIST MYTH: WHY IRAN WANTS NUCLEAR WEAPONS
Charles C. Mayer-Major, United States Air Force
B.A., University of Minnesota, 1989
Master of Arts in Security Studies (Defense Decision-Making and Planning)-September 2004
Advisors: Peter R. Lavoy, Department of National Security Affairs
James A. Russell, Department of National Security Affairs

Throughout twenty-five years of strained relations, U.S. policy efforts have delayed but not thwarted Iran’s clandestine nuclear weapons program, largely because Washington has failed to influence Iran’s motivations for acquiring nuclear weapons.

There are three main motivations behind Iran’s nuclear program. First, at the systemic level, external threats drive Iran’s perceived need for a nuclear deterrent. Second, at the individual level, well placed governmental elites propel the nuclear security myth to spur nationalistic support for nuclear weapons. Third, at the state level, institutional bureaucracies, created to build Iran’s nuclear infrastructure, now compete against other organizations for their own self interests that are closely associated with the continued development of nuclear weapons.

This thesis recommends three policy tracks, addressing causal factors at each level. First, the United States should try to create a new Gulf Security organization, including Iran and the new Iraqi government, to build a collective security environment without nuclear weapons. Second, Washington should build a multilateral coalition to contain Iranian proliferation activities while offering economic incentives for Iranian disarmament. Third, the United States should work to discredit Iran’s nuclear security myth by fostering a public debate within Iran on the costs of nuclear weapons, using U.S.-run media.

THEATER NUCLEAR WEAPONS IN EUROPE: THE CONTEMPORARY DEBATE
Brian G. Polser-Major, United States Air Force
B.A., University of Washington, 1990
Master of Arts in Security Studies (Defense Decision-Making and Planning)-September 2004
Advisors: Jeffrey W. Knopf, Department of National Security Affairs
Peter R. Lavoy, Department of National Security Affairs

Are U.S. nuclear weapons still needed in Europe now that the threat that brought them there is gone? This thesis examines whether basing theater nuclear weapons (TNW) in Europe is useful, irrelevant, or counterproductive in maintaining European security. U.S. and NATO policymakers adhere to political and military utility arguments, while others argue that TNWs in Europe are irrelevant because their utility has been supplanted by political, cultural, and economic interdependence, modern conventional capabilities and the existential deterrent of U.S. strategic nuclear weapons. Nonproliferation and arms control advocates argue that TNWs are counterproductive because they enhance rather than deter proliferation, undermine the Nuclear Nonproliferation Treaty (NPT) and impede cooperation in the NATO-Russia security relationship.

This thesis demonstrates how economic and political ties, including widespread participation in nuclear planning, the increasing importance of the nuclear taboo, prospects for conventional deterrence and the U.S. strategic nuclear umbrella render TNWs in Europe irrelevant. Emphasizing their utility provides incentive for others to join the “nuclear club,” degrades the nonproliferation regime and creates a roadblock for NATO-Russian arms control and counterproliferation efforts. This thesis recommends withdrawing U.S. theater nuclear weapons from Europe, relying instead on a strategy of conventional deterrence and reassurance while maintaining general nuclear deterrence via strategic forces.

KEYWORDS: Nuclear Weapons, Theater Nuclear Weapons, Deterrence, Nonproliferation, Counterproliferation, Arms Control, Europe, Security

THE NATIONAL GUARD BALLISTIC MISSILE DEFENSE MISSION: MINUTEMEN AT THE ORBITAL PLANE
Ralph H. Trenary, III-Major, Colorado Army National Guard
B.A., University of Northern Colorado, 1985
Master of Arts in Security Studies (Civil-Military Relations)-September 2004
Advisor: Harold A. Trinkunas, Department of National Security Affairs
Second Reader: Archie D. Barrett

This thesis examines the decision to assign the Ballistic Missile Defense mission to units of the Colorado and Alaska National Guard. The history of the Nike Ajax, Nike Hercules, Sentinel and Safeguard programs are examined to identify the origins of support for this decision. First-hand sources provide evidence that the National Guard performance in the Nike air defense program is a record of parity and some superiority to equivalent active Army units. Previously documented records of Nike unit inspections and evaluations are included. Perhaps for the first time, the results of a declassified U.S. Army study accepting National Guard participation in the Sentinel/Safeguard missions is reported. Pressures, competing interests and election politics within the context of the American government institutions provide insights into the difficult path to President George W. Bush's 2004 operational declaration and the uncertainties lying ahead for the Missile-Age Minutemen. The international relations section of this thesis includes an overview of the sources of the missile threat to the United States, its friends and allies. With the demise of the Anti-Ballistic Missile Treaty, this thesis gauges the impacts on diplomacy and shifting priorities and resources within the U.S. Defense structure. The author concludes with personal observations and recommendations.

A U.S.-led Naval operation in October 2003 interdicted a shipment of uranium-enrichment components on-board a German cargo ship traveling from Dubai to Libya. In December 2003, Libya announced it would halt its weapons of mass destruction (WMD) programs and eliminate its existing stockpiles under international verification and supervision. The George W. Bush Administration proclaimed the interdiction a triumph for the newly created Proliferation Security Initiative (PSI), an activity which was announced five months earlier to interdict (through the threat or actual use of force) land, sea, and air trafficking of WMD at the earliest possible point.

Despite increasing international support, numerous joint exercises, and the successful Libyan intercept, the PSI faces serious legal, intelligence and operational challenges to sustained effectiveness. This thesis looks closely at these challenges and how to overcome them. The author concludes that overcoming these challenges will require a multilateral trusted information network to augment secretive bilateral intelligence sharing, a PSI-specific legal umbrella to replace current reliance on partially applicable international laws and resolutions and an interoperable team approach to operations that takes advantage of industry’s technological improvements in detection technology while considering air-intercept restrictions.

KEYWORDS: Interdiction, Proliferation Security Initiative, PSI, Weapons of Mass Destruction, WMD, Intelligence, Legal, Operational, Challenges
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