

Naval Postgraduate School  
Monterey, California 93943-5138



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# Compilation of Theses Abstracts

June 2005



**Office of the Associate Provost and Dean of Research  
Naval Postgraduate School**

# Report Documentation Page

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## PREFACE

This publication contains unrestricted abstracts (unclassified or unrestricted distribution) of theses submitted for the degrees Doctor of Philosophy, Master of Business Administration, Master of Science, and Master of Arts for the June 2005 graduation. Classified and restricted distribution abstracts are available over the NPS SIPRnet.

This compilation of abstracts of theses is published in order that those interested in the fields represented may have an opportunity to become acquainted with the nature and substance of the student research that has been undertaken. Copies of theses are available for those wishing more detailed information. The procedure for obtaining copies is outlined on the last page of this volume.

For additional information on programs, or for a catalog, from the Naval Postgraduate School, contact the Director of Admissions.

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The *Compilation of Theses Abstracts* (unrestricted) can be found on-line at <http://www.nps.edu/Research/>. *NPS Research*, a tri-annual publication highlighting faculty and student research and *Summary of Research*, an annual publication of research projects and publications, are also available on-line.



# INTRODUCTION

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## 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.

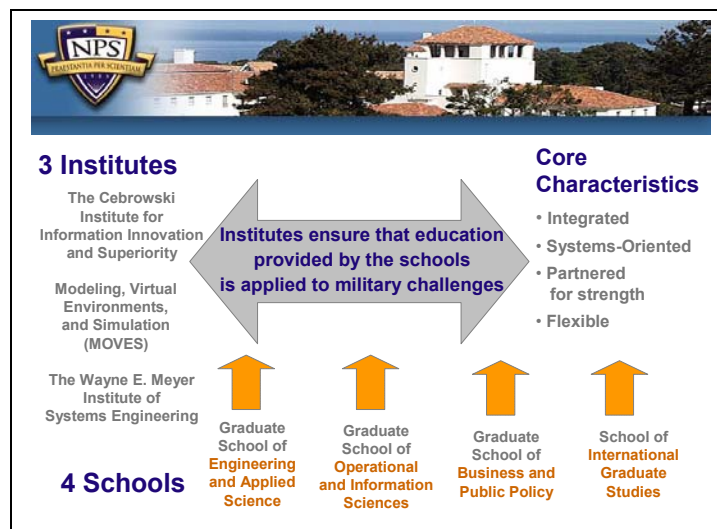
The research program at NPS exists to support the primary mission of graduate education. Research at NPS:

- 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.



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# INTRODUCTION

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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
- International Security: Post Conflict Security Building
- National Security and Intelligence
  - Europe/Russia/Central Asia
  - Far East/South-East Asia/Pacific
  - Middle East/Africa/South Asia
  - Western Hemisphere

## **Interdisciplinary Curricula**

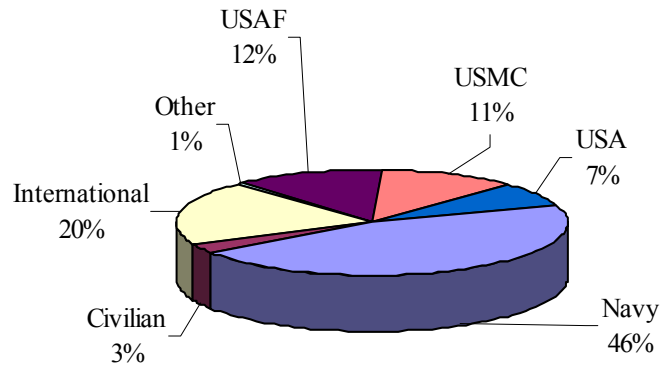
- Modeling, Virtual Environments and Simulation
- Product Development
- Space Systems Engineering
- Space Systems Operations
- Space Systems Operations International
- Systems Engineering and Analysis
- Systems Engineering Management
- Undersea Warfare

## **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 2005 is shown in Figure 1 on the following page.

# INTRODUCTION

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**Figure 1: Resident Degrees/Subspecialty Student Population for June 2005  
(Total Enrollment: 1,457)**

\* 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

### Software Engineering

Space Systems Engineering  
Space Systems Operations  
Systems Engineering  
Systems Engineering and Analysis  
Systems Engineering Management  
Systems Technology

### **Engineer Degrees**

Astronautical Engineer  
Electrical Engineer  
Mechanical Engineer

### **Doctor of Philosophy**

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

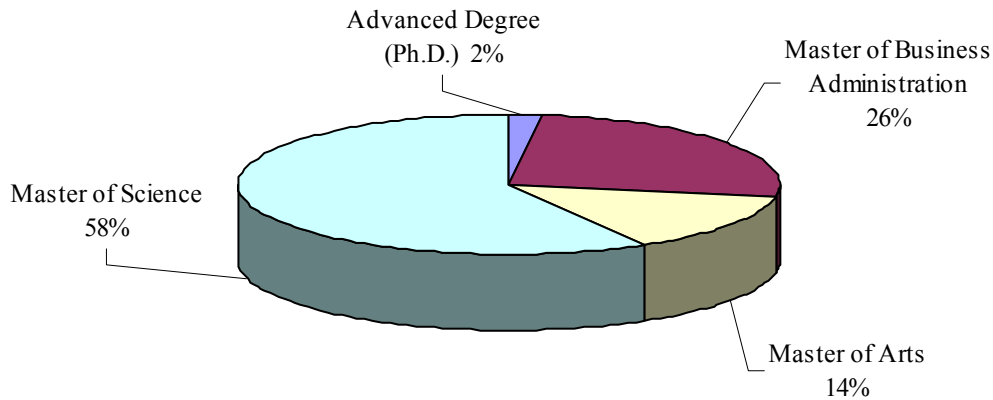
### **Doctor of Engineering**

Astronautical Engineering  
Engineering Acoustics  
Mechanical Engineering

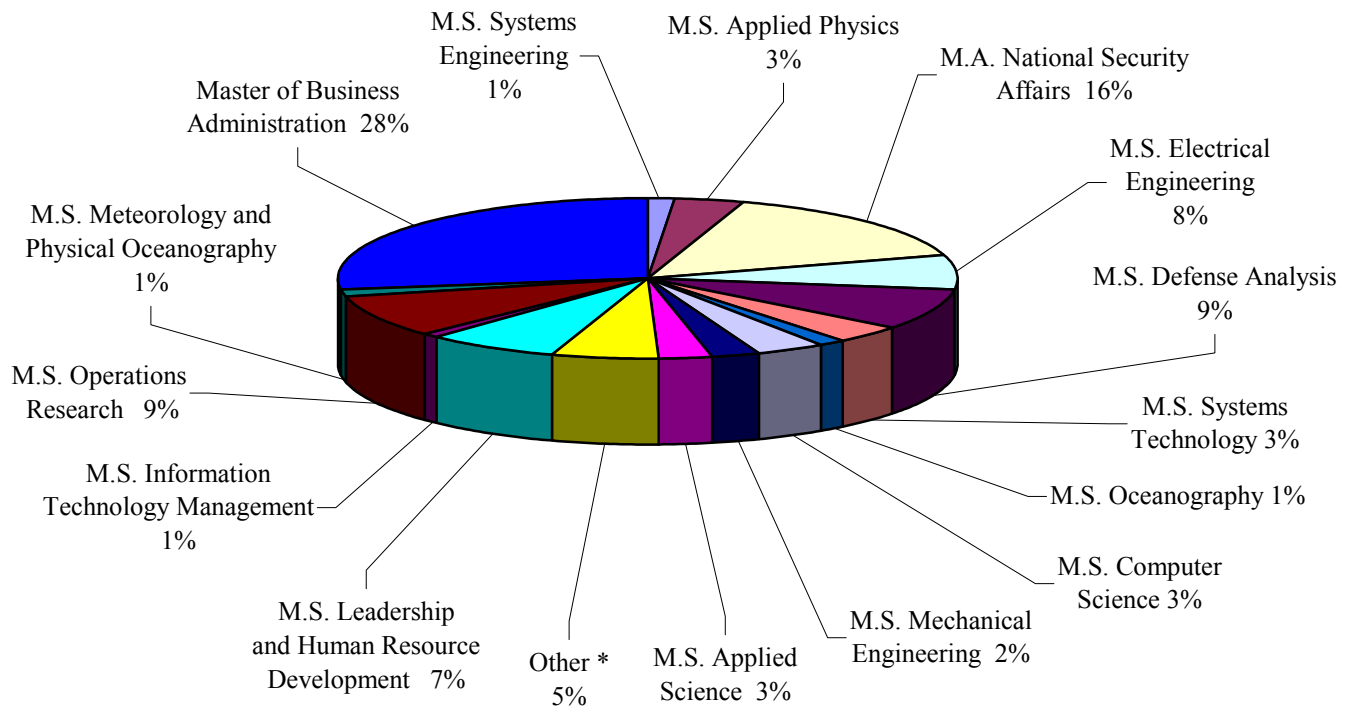
# INTRODUCTION

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There were 249 degrees conferred in June 2005. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.



**Figure 2. Distribution by Degree Type  
(249 Degrees Conferred)**



**Figure 3. Degrees Conferred in June 2005  
(249 Degrees Conferred)**

Other\* Ph.D. Computer Science (1), Ph.D. Electrical Engineering (1), M.S. Aeronautical Engineering (1), M.S. Applied Mathematics (2), M.S. Astronautical Engineering (1), M.S. Contract Management (1), M.S. Engineering Acoustics (2), M.S. Information Systems and Operations (1), M.S. Management (1), M.S. Meteorology (1), M.A. Security Studies (2), M.S. Space Systems Operations (1).

# INTRODUCTION

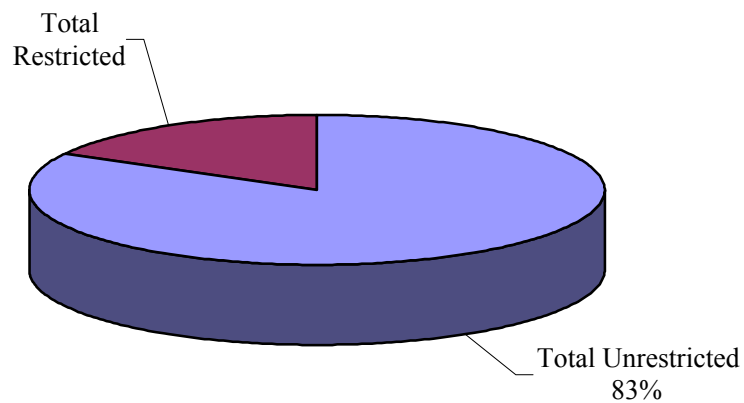
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## Thesis

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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**MASTER  
OF  
BUSINESS ADMINISTRATION**



# MASTER OF BUSINESS ADMINISTRATION

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## THE EXTENT OF DEPARTMENT OF DEFENSE (DOD) INFLUENCE ON THE DEVELOPMENT AND APPLICATION OF RADIO FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY IN THE CIVILIAN SECTOR

**Rafael A. Acevedo-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2005**

**Robert W. Cooper-Lieutenant, United States Navy**

**Master of Business Administration-June 2005**

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It would be a fair argument to say that there is perhaps no invention that has had as much impact on the world as that of the Internet. The Internet, however, was conceived in the minds of government employees. Just as government influenced the development of the Internet, the same can be said of Radio Frequency Identification (RFID) Technology. The Department of Defense (DoD) had a very large impact on the development of RFID. Many DoD funded projects and experiments helped pave the way for and significantly influenced the development of RFID technology. This project examines the extent of that DoD influence and shows the correlation between DoD and RFID developments in the civilian sector. From Defense projects in minefield location to tracking containers in ships on the high seas in support of the war on terror, this project explains how specific government sponsored projects had a direct influence on the current state of RFID technology.

**KEYWORDS:** RFID, Radio Frequency Identification, Minefield Detection, Savi, Container Tracking, Logistics

## THE USE OF SYSTEM DYNAMICS ANALYSIS AND MODELING TECHNIQUES TO EXPLORE POLICY LEVERS IN THE FIGHT AGAINST MIDDLE EASTERN TERRORIST GROUPS

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**Master of Business Administration-June 2005**

**Masahiro Matsuura-Lieutenant Commander, Japan Navy**

**Master of Business Administration-June 2005**

**Carlos Molina Monzon-Lieutenant Commander, El Salvador Navy**

**Master of Business Administration-June 2005**

**Ioannis Samothrakis-Lieutenant Commander, Hellenic Navy**

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**Second Reader: John E. Mutty, Graduate School of Business and Public Policy**

The objective of this project is to use analysis and modeling techniques of systems dynamics to capture the causal relationships of Middle Eastern groups' terrorist activities against the U.S. based on their ideological drivers, as well as the effect of U.S. policies that create dynamics and affect performance and outcomes. The main focus of this analysis is the terrorist groups' human resources. The hypothesis is that Middle Eastern terrorism against the U.S. is affected by the level of U.S. military presence and/or investment in the Middle Eastern nations. A considerable and lasting reduction in fatalities originated by Middle Eastern groups' terrorist attacks against the U.S. can be achieved through a policy that reduces both the human resources available to terrorist groups and their attack capability (level of sophistication). The study covers the implications of this resource reduction policy, which may include incremental military investment, defection motivators, anti-terrorism and the use of counter-terrorism operations. These operations will

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reduce the sophistication as well as the recruitment rate to levels where cells' functionality will be impaired, and thus unable to carry high lethality attacks.

**KEYWORDS:** Terrorism Aimed at the United States, Terrorism Dynamics, Dynamic Modeling of Terrorism and Terrorism Dynamic Behavior

## **THE PHOTOVOLTAIC POWER CONVERTER: A TECHNOLOGY READINESS ASSESSMENT**

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**Master of Business Administration-June 2005**

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**Master of Business Administration-June 2005**

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**Brad R. Naegle, Graduate School of Business and Public Policy**

With the Department of Defense (DoD) moving towards evolutionary acquisition and incremental development of weapons systems and soldier applications, it is important that the maturity of new technologies be properly assessed so that the probability of success, once inserted into a program, can be maximized.

The purpose of this report is to examine the Photovoltaic Power Converter (PVPC) technology, developed by Atira Technologies, as a potential Department of Defense acquisition program/project. Specifically, the report focuses on a Technology Readiness Assessment (TRA). The report validates the PVPC technology and estimates, with 95% confidence, that the PVPC enables a solar power system to convert between 30.39% and 48.60% more solar energy into power than an identical system without the PVPC. The report also identifies and documents the required supporting information to justify a Technology Readiness Level (TRL) 5 for the PVPC. Finally, the report recommends inserting the PVPC into the DoD acquisition system as a commercial item via horizontal technology insertion or the Advanced Concept Technology Demonstration Program.

**KEYWORDS:** Photovoltaic, PV, Technology Readiness Level, TRL, Atira, Photovoltaic Power Converter, PVPC, Commercial Item, Advanced Concept Technology Demonstration

## **PERFORMANCE METRICS FOR THE PROGRAM EXECUTIVE OFFICE FOR INTEGRATED WARFARE SYSTEMS 1.0 AND 2.0**

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**Kenneth J. Euske, Graduate School of Business and Public Policy**

There is an obvious need for performance measurement in U.S. Navy commands. Not only are performance metrics, or measurements, essential to tracking progress toward strategic goals, but also, as a publicly funded entity and holder of the public trust, the Navy has an obligation to efficiently and effectively use those public funds. Performance metrics are the guideposts to achieving efficiency and effectiveness. This thesis is designed to aid the Program Executive Office for Integrated Warfare Systems, a Navy Echelon III acquisition command, with a performance measurement project, deriving metrics for two of its seven major programs, IWS 1.0 and 2.0. Performance drivers are captured through interviews with key leaders in those two major programs. Those interviews are transformed into causal performance maps, which depict the interplay of the drivers and the outcomes they influence. Performance metrics are then derived for those drivers and outcomes and arranged in a balanced scorecard format. The scorecards will hopefully be useful to the major program managers in monitoring the progress of their organizations toward achieving strategic success. Additionally, the metrics should enhance understanding of strategic direction by the rank and file of IWS 1.0 and 2.0.

**KEYWORDS:** Performance Metric, Critical Performance Variable, Causal Performance Map, Balanced Scorecard, Ethnographic Interview, Performance, Critical Success Factor

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## **ENLISTED NAVY RESERVISTS AND THEIR INTENTION TO STAY IN THE NAVY RESERVES UNTIL RETIREMENT ELIGIBLE**

**Rita Alice Becker-Lieutenant Commander, United States Navy Reserve  
Master of Business Administration-June 2005**

**Advisor: Kathryn Kocher, Graduate School of Business and Public Policy  
Second Reader: Elda Pema, Graduate School of Business and Public Policy**

This thesis examines factors that influence the retention of enlisted members in pay grades E1-E5 and E6 in the Selected Navy Reserve. Data were extracted from the 2000-2001 Navy Reserve Career Decisions Survey. Chi-square tests of independence were used to assess the relationship of various demographic, unit-type, critical-rate, and reserve experience variables to plans for retention to retirement eligibility. Thirteen factors significantly associated with planned retention for E1-E5s and ten for E6s are identified. E6s indicate a higher retirement intention rate than do E1-E5s. For both pay grade groups, males indicate a higher retirement intention rate than do females and married members indicate a higher retirement intention rate than do non-married members. E1-E6 Prior Service members indicate a higher retirement intention rate than do E1-E6 Non Prior Service members. For both groups, Reserve Center/Readiness Command unit type is positively associated with planned retention while aviation and shipboard unit types are not significantly related. For E1-E5s, retirement intent is positively related to serving in a critical rating, while it is not for E-6s. For E1-E6s, retention plans are also strongly dependent on opinions about quality of training, accomplishment recognition, family impact, civilian job impact, educational benefits and senior leadership.

**KEYWORDS:** Navy Reserve Retention, Reserve Retention, Military Retention, Navy Reserve Manpower, Attrition

## **EARMARKS AND THE FISCAL YEAR 2005 DEFENSE APPROPRIATIONS ACT: A STUDY OF CONGRESSIONAL CONTROL OF THE DEPARTMENT OF DEFENSE (DOD)**

**John J. Bergeron-Major, United States Marine Corps  
Master of Business Administration-June 2005**

**Advisor: Jerry L. McCaffery, Graduate School of Business and Public Policy  
Second Reader: John E. Mutty, Graduate School of Business and Public Policy**

The purpose of this project is to analyze how Congress controls the Department of Defense (DoD) through the budget review process. The project looks at the Congressional marks made to the Defense Appropriations Act. During the Congressional review of the Defense Budget, changes are made by Congress in order to control the DoD. These changes are not requested by the DoD and in many cases may be programs that are of special interest to members of Congress. This thesis focuses on how Congress uses earmarks to control the DoD. It considers the extent to which these changes are in the best interest of national defense. This project analyzes the Defense Appropriations Act for fiscal year 2005, with special regard to the U.S. Marine Corps accounts.

**KEYWORDS:** Defense Appropriations Act, Defense Budget, Congressional Budget Review Process

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## **OPERATION SOLAR EAGLE: A STUDY EXAMINING PHOTOVOLTAIC (PV) SOLAR POWER AS AN ALTERNATIVE FOR THE REBUILDING OF THE IRAQI ELECTRICAL POWER GENERATION INFRASTRUCTURE**

**Ralph Borja-Major, United States Army**

**Master of Business Administration-June 2005**

**Jeffery Phillips-Major, United States Army**

**Master of Business Administration-June 2005**

**Curtis Austin-DoD Civilian**

**Master of Business Administration-December 2005**

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**Brad R. Naegle, Graduate School of Business and Public Policy**

The purpose of this project is to examine the cost and feasibility of using photovoltaic solar power to assist in the rebuilding of the Iraqi infrastructure. The project examines available solar equipment and technologies coupled with requirements for operation, installation and maintenance of such systems. The report begins with an analysis of the current state of the Iraqi infrastructure, with special emphasis placed on identifying potential candidates for initial solar system installation. Next, the report addresses available commercial solar equipment and emerging technologies that enhance such systems. This section addresses areas including installation, operation, maintenance and durability. Finally, the report concludes with a cost estimate for using solar systems in the rebuilding of Iraq. At the conclusion of the project, information is made available for decision makers to include as part of an operations order or to attach as an annex to an existing operations order.

**KEYWORDS:** Solar Power, Photovoltaic, PV, Rechargeable Batteries, Logistics, BA-5590, BB-390, BB-2590, PVPC, Iraq, Power Grid, Infrastructure, Cost Estimate, Photovoltaic Power Conversion, PVPC, Solar PV System, Vines, MPPT

## **A STUDY ON PERFORMANCE BASED LOGISTICS/PERFORMANCE BASED SERVICE ACQUISITIONS AND THEIR APPLICABILITY TO TURKISH NAVY SERVICE ACQUISITION ACTIVITIES**

**Atilla Bozkurt-Lieutenant Junior Grade, Turkish Navy**

**Master of Business Administration-June 2005**

**Aykut Caglar Guducu-Lieutenant Junior Grade, Turkish Navy**

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**Second Readers: Jeffrey R. Cuskey, Graduate School of Business and Public Policy**

**Keebom Kang, Graduate School of Business and Public Policy**

The purpose of this MBA professional report is to investigate and analyze Performance Based Logistics (PBL)/Performance Based Service Acquisitions (PBSA) and provide implementation alternatives for Turkish Navy service acquisitions. This research includes a literature review and background information about PBL and PBSA; current PBL and PBSA implementations in the United States; current Turkish acquisition rules and regulations, along with the legal constraints as to the applicability of PBSA; Turkish Navy service acquisition activities and associated problematic areas; problems with the implementation of PBL and PBSA in the U.S. and recommendations for alternative implementation solutions based on the findings.

**KEYWORDS:** Performance Based Logistics, PBL, Performance Based Service Acquisitions, PBSA, Performance Metrics, Turkish Acquisition Rules and Regulations, Administrative Specifications Document, Technical Specification Document, Award Fee, Contracting Methods, PBL Implementation Model

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## DEPARTMENT OF THE NAVY (DON) PROCUREMENT METRICS EVALUATION

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Master of Business Administration-June 2005**

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Kenneth Euske, Graduate School of Business and Public Policy**

The purpose of this MBA Project is to investigate and provide a comprehensive evaluation of the current Department of the Navy Procurement Metrics collected by the Office of the Deputy Assistant Secretary of the Navy for Acquisition Management. This project is conducted at their request and with their support. The goal of this project is to determine if the current metrics are the appropriate procurement performance measures. Specifically, this MBA Project attempts to answer three questions: (1) do the metrics align with strategy? (2) can they be measured effectively? and (3) are they linked to value? The framework used to explore these questions is Robert Simon's *Levers of Control* model. These procurement metrics are part of a Diagnostic Control System and are being evaluated as such. Simon's *Nature of Measures* model is also used in the analysis and helps determine metric objectiveness, completeness and responsiveness.

**KEYWORDS:** Management Control Systems, Diagnostic Control Systems, Procurement Metrics, Performance Measures, Nature of Measures

## DECISION-SUPPORT QUANTITATIVE MODELS FOR VALUING INCENTIVES IN PERFORMANCE BASED CONTRACTS

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**Michael Aguilar-Captain, United States Marine Corps  
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**Jeffrey J. Myers-Lieutenant, United States Navy  
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Uday Apte, Graduate School of Business and Public Policy  
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The purpose of this MBA project is to identify the actual cost savings when a Performance Based Logistics (PBL) contract, with incentives, is awarded to replace a specified maintenance echelon for critical components or subcomponents of systems. The impact on system availability is examined to determine if a proposed investment is practical. The entire logistics flow and maintenance processes, to include all associated sub-activities, is analyzed. In order to do this, researchers identify all costs of operating the current organic maintenance echelon, which becomes the PBL baseline. This is used to determine the value added of any incremental percentage change in readiness or elimination of organic maintenance echelon(s). Researchers propose to develop a simulation-based decision support tool to assist Program Managers (PM) with issues of valuing options for the improvement of system availability, and making appropriate investment options. Ultimately, this project will determine the financial viability and practicality of implementing a PBL incentive contract.

**KEYWORDS:** Performance Based Logistics, Inherent Reliability, Contract Incentives, Decision Support Tool

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## AN ANALYSIS OF THE MARRIAGE AND DEPENDENCY PREMIUM AMONG ACTIVE DUTY NAVY PERSONNEL

**Ronald A. Fauntleroy-Lieutenant Junior Grade, United States Naval Reserve  
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**Second Reader: David Henderson, Graduate School of Business and Public Policy**

Within the Navy, married active duty service members and unwed single sailors with dependents are entitled to receive additional benefits compared to their single counterparts. The majority of these benefits are received through increases in the service member's Basic Allowance for Housing, Family Separation Allowance and medical coverage for spouses and dependents. The intention of this study is to determine how much these increases cost the Navy. Data acquired from the Center for Defense Manpower Data Center and the Center for Naval Analyses is used to determine the average increase in BAH, FSA and medical coverage costs for married sailors and unwed single sailors with dependents. The total cost to the Navy is then compared to marriage premium estimates found within the civilian labor market. Surprisingly, the marriage and dependency premium within the Navy is found to be far less than the marriage premium in the civilian labor market.

**KEYWORDS:** Marriage Premium, Single Service Members, Basic Allowance for Housing, Family Separation Pay, Military Benefits, Military Marriage, Military Spouse

## ANALYSIS OF TOBYHANNA ARMY DEPOT'S RADIO FREQUENCY IDENTIFICATION (RFID) PILOT PROGRAM: RFID AS AN ASSET MANAGEMENT TOOL

**Brian D. Forrest-Major, United States Army  
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**Keith W. Miertschin-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2005**

**Advisors: Nicholas Dew, Graduate School of Business and Public Policy**

**E. Cory Yoder, Graduate School of Business and Public Policy**

The purpose of this MBA project is to identify the potential value of Radio Frequency Identification (RFID) used for inventory and asset management at the Tobyhanna Army Maintenance Depot. Tobyhanna Army Depot recently partnered with WhereNet Corporation for a pilot program to incorporate a real-time locating system that uses RFID. The pilot program tracks the AN/TPS-75 and AN/TRC-170 systems through the maintenance processes to determine if RFID is beneficial. The RFID asset management system proved beneficial to increase process efficiency and reduce the number of wasted labor hours used to find misplaced items. The cost-benefit analysis at the Tobyhanna Army Depot RFID pilot program indicates a Return on Investment of less than one year and supports previous research conducted on RFID as an asset management tool. Tobyhanna's investment in advancing technology essentially paid for itself within one year, when measured in labor cost savings, and yielded an annual savings of 837 Repair Cycle Time days. Since the primary infrastructure for RFID is already funded and fully operational, the payoff period on incremental investment is likely to be much shorter in the future.

**KEYWORDS:** Radio Frequency Identification, Asset Management, Maintenance Depot

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### **COMMANDER NAVAL AIR FORCES (CNAF) FLIGHT HOUR PROGRAM: BUDGETING AND EXECUTION RESPONSE TO THE IMPLEMENTATION OF THE FLEET RESPONSE PLAN AND OP-20 PRICING MODEL CHANGES**

**Walter H. Glenn, Jr.-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2005**

**Eric E. Otten-Lieutenant Commander, United States Naval Reserve  
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Effectively managing the Navy Flight Hour Program (FHP) has historically posed unique challenges. Most notably, Commander, Naval Air Forces (CNAF) FHP managers have routinely faced a seemingly unavoidable shortfall in flight hour funding requiring the use of creative cash management practices and reliance on defense supplemental appropriations to continue flight operations to the end of each fiscal year. In an effort to reduce this disparity between budget forecasts and actual program execution requirements, significant changes were recently made to individual pricing models used in formulating OP-20 funding levels. In addition, the Navy's transition to the Fleet Readiness Training Plan (FRTTP) in support of the overall Fleet Response Plan (FRP) in July of 2003 resulted in a fundamental shift in funding level requirements and overall program execution.

The purpose of this study is to analyze what effect the response to this fundamental shift in the Navy's overall readiness posture, in conjunction with the aforementioned OP-20 budgetary process enhancements, had on the matching of budgeted program dollars with execution requirements.

The methodology for the study entails an analysis into the specific changes to the budgeting models used in the formulation of OP-20 funding levels, along with a review of the resulting execution changes at COMNAVAIRPAC (CNAP) in support of the FRP.

**KEYWORDS:** CNAP Flying Hour Program, OP-20, Cash Management, Naval Aviation

### **SUPPLY AND DEMAND FOR BUSINESS EDUCATION IN NAVAL AVIATION**

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In light of the Navy's transformation plan, advanced business education is increasing in importance. As part of the Navy's *Sea Power 21* strategy, Sea Enterprise encourages Naval Aviation to steer historical management practices towards better business practices. As pilots and Naval Flight Officers evolve from Mission Commander to Commanding Officer, they must be equipped with requisite business skill sets to engage the challenge of balancing aircraft modernization with current readiness. This project analyzes the supply and demand for postgraduate business education to determine how prepared Naval Aviation is to achieve long-term transformation objectives. The results show that 25 percent of all aviation officers (O-1 to O-6) have a graduate business degree; 17 percent of Commanding Officers with advanced degrees have a business specialization; and 2.5 percent of aviation officer billets require a postgraduate business degree. Recommendations to better prepare the aviation community for the Sea Enterprise environment include (1) early emphasis of graduate business education, (2) promoting advanced business education as a major career milestone, (3) tying first shore tour assignments to graduate business education, and (4) increasing the overall billet requirement for advanced business degrees. These improvements may greatly enhance the Navy's efforts towards achieving its transformation goals.

**KEYWORDS:** Naval Aviators, Naval Aviation, Aviation Officer Career Paths, Graduate Business Education, NPS Executive MBA

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## **THE RAVEN SMALL UNMANNED AERIAL VEHICLE (SUAV), INVESTIGATING POTENTIAL DICHOTOMIES BETWEEN DOCTRINE AND PRACTICE**

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**Master of Business Administration-June 2005**

**William J. Snodgrass, Jr.-Major, United States Army**

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**Brig Gen Raymond E. Franck, USAF (Ret.), Graduate School of Business and Public Policy**

In this MBA project, potential differences between doctrine and practice in the employment of the Raven Small Unmanned Aerial Vehicle (SUAV) are investigated. The last review of the SUAV operational requirements was conducted in 2003 and left a gap by not specifically addressing its usage on the battlefield. In an attempt to fill that gap, this project focuses on the real-world usage of the Raven SUAV system and compares doctrine versus practice using the Department of Defense's (DoD) Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities (DOTML-PF) model as the primary logic construct. The study then takes an in-depth look at doctrine and practice using DOTML-PF as the model for revealing potential differences between the two. Finally, the authors analyze these differences and recommend solutions to help mitigate shortfalls in actual Raven SUAV usage on the battlefield.

**KEYWORDS:** Raven, Small Unmanned Aerial Vehicle, SUAV, Raven SUAV, Dragon Eye, Future Combat Systems, FCS Class I/II UAV, Shadow, Predator

## **JOINT CONTINGENCY CONTRACTING**

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**Bryan H. Paton-Captain, United States Marine Corps**

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**Lisa A. Haptonstall-DoD Civilian**

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The purpose of this MBA professional report is to investigate and analyze the means by which Contingency Contracting Officers (CCO) can effectively operate in a Joint contingency environment and to validate the Defense Contract Management Agency's (DCMA) entry and exit criteria for contingency contracting missions. Joint contingencies encompass regional conflicts, humanitarian and peacekeeping missions, and international or domestic disaster relief missions supported with the immediate deployment of military forces.

This research is accomplished by reviewing the current guidance, policies, and doctrine pertinent to contingency contracting operations and conducting personal interviews. The researchers conduct interviews with representatives of the Joint Staff, J4 (Logistics), each service component's acquisition headquarters, U.S. Central Command's J4 (Logistics), U.S. Pacific Command's J4 (Logistics, Engineering, and Security Assistance) and the DCMA to explore how contingency contracting operations are planned and executed, current issues and lessons learned, and to understand the current structure/organization of service component and combatant command for accomplishing contingency contracting.

Conclusions and recommendations address perceived shortfalls in planning for, communicating, and executing contingency contracting operations. Methodologies the services' CCOs and the DCMA could employ to more effectively prepare for their contingency contracting missions are explored, including a model to improve manning, experience, and structure to accomplish contingency contracting operations. The feasibility of establishing a Joint Contingency Contracting Command (JCCC) within the Department, which would have the responsibility of controlling the actions of contingency contracting in theater, is also explored.

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**KEYWORDS:** Contingency, Contracting, Contingency Contracting, Joint Contingency Contracting

## AN ANALYSIS OF THE SEA ENTERPRISE PROGRAM

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The possibility of realizing savings to modernize and recapitalize the U.S. Navy is of great importance to the Department of the Navy (DoN). Sea Enterprise is the vehicle for this effort. The DoN operates in an increasingly smaller, dangerous and rapidly changing world. Hence, the Navy and Marine Corps are attempting to change, adapt and transform to meet new threats to the United States in the twenty-first century.

This thesis examines the Sea Enterprise Program from its inception in June 2002 to May 2005. A number of common business, public service, and management concepts are extracted and used to analyze the effort as a whole. The goals and objectives, structures, responsibilities, processes and results to date of Sea Enterprise are documented and recommendations are provided that may aid the acceleration of the effort.

The results of this thesis reveal some identifiable challenges and issues that have inhibited the DoN's ability to realize the vision of Sea Power 21, and thus realize savings. Cultural resistance to change, onerous bureaucratic frameworks, lack of accountability, and disincentives to save are a few examples of barriers the Navy must overcome. To realize savings, recapitalize the fleet and meet the twenty-first century threat (principally, the Global War on Terrorism (GWOT)), the Navy must address and surmount such barriers.

**KEYWORDS:** Sea Enterprise, Sea Power 21, Culture Change, Leadership, Execution, Barriers to Efficiency, Change Initiatives, Change Management, Innovation, Incentives, Center for Navy Business Intelligence, Enterprise Resource Accounts, Cutback Management

## A FIRST STEP TOWARDS ZERO DOWN TIME: THE CREATION OF SYNERGY THROUGH EQUIPMENT ACQUISITION WITHIN THE CONSTRAINTS OF A SMALL BUDGET IN AN ARMY WITH CIVILIAN OVERSIGHT - A CASE OF THE BOTSWANA DEFENCE FORCE (BDF)

**Mothusi Glendon Mompoti-Captain, Botswana Defence Force**

**Master of Business Administration-June 2005**

**Advisor: Keebom Kang, Graduate School of Business and Public Policy**

**Second Reader: John Dillard, Graduate School of Business and Public Policy**

This thesis seeks to explore the satisfaction levels for variables that should be considered when procuring equipment in the Botswana Defence Force (BDF). It is believed that this investigation should lead to a statistical model specific to the BDF's procurement methods. New methods of acquisition are now demanded by the PPADB; hence new metrics have to be applied to strike an accord with the new requirements of buying for government. The null hypothesis,  $H_0$ , for this thesis is that downtime or turnaround time (TAT) cannot be reduced by favorable independent variables. This follows from the preliminary conclusion that there is substantial downtime at present. It postulates that something can be done to ameliorate past mishaps. The null hypothesis therefore assumes that this will continue to prevail no matter what is done. The alternative hypothesis,  $H_a$ , is that TAT can be reduced by favorable independent variables. The results show substantial dissatisfaction with the procurement methods of the BDF. Further research is recommended in the light of the weakness of the resultant regression model, which gave  $R^2 = 29\%$ .

**KEYWORDS:** Acquisition/Procurement, Downtime/Turnaround Time, Reliability, Availability, Operational Availability, Maintainability, Asset Visibility, Armory, Inventory, Defence Council, Nominal Data, Interval Data, Total Obligation Authority

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## ENERGY SYSTEMS OF UKRAINE: CHARACTERISTICS, DEPENDENCE, AND INFLUENCE ON ECONOMIC AND POLITICAL SELF-DETERMINATION

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**Master of Business Administration-June 2005**

**Advisors: Brig Gen Raymond E. Franck, USAF (Ret.), Graduate School of Business and Public  
Policy**

**Michael Melich, Wayne E. Meyer Institute of Systems Engineering and Department of Physics**

The purpose of this thesis is to conduct an analysis of the current composition of Ukrainian energy systems, analyze its dependence on Russian energy sources, explore alternatives to diversify the supply of fuel resources and offer insights on the best possible solution for Ukraine. Currently, a substantial part of energy in Ukraine is produced with gas and oil supplied from Russia. A monopoly supplier might render the domestic economy dependent upon a foreign country. This might give the supplier country an opportunity to control and dictate. The Russian President and much of the political leadership did not support the most recent political developments in Ukraine (e.g., Presidential elections, "Orange Revolution"). Ukraine's political goals include development of closer cooperation with the EU, U.S. and NATO. This would not match Russian foreign policy interests towards former Soviet Republics. Economic influence by Russia could be used to influence Ukrainian foreign policy. The goals of this thesis are to show that the search for alternative sources of energy for Ukraine is a very important aspect for economic and political independence, and also to identify alternatives for the development of the Ukrainian energy market.

**KEYWORDS:** Ukraine-Russia Relations, Energy System of Ukraine, Ukrainian Economic Independence, Russian Economic Influence, Ukrainian Energy Market Development

## ALTERNATIVE ASSIGNMENT INCENTIVE PAY FORMATS

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**Jesus S. Moreno-Lieutenant, United States Navy**

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**John E. Mutty, Graduate School of Business and Public Policy**

This MBA professional report investigates and analyzes experiments designed to evaluate the efficiency of alternative auction formats when auctions are used to determine individual assignments for one of several available jobs. During these assignment auctions, bids consist of compensation requests and the subjects are presented with multiple jobs over which to bid. The structure of their bids will be compared across alternative rules for determining job assignments. Also, this research report investigates and analyzes the success of the Assignment Incentive Pay (AIP) auction format. In addition, this research addresses and reviews the Navy's current policy, guidance and doctrine for billet assignment. Furthermore, the report includes recommendations on how the U.S. Navy can effectively develop a theoretical model of bidding behavior with testable hypotheses, and provides preliminary results on these hypotheses.

**KEYWORDS:** Alternative Assignments, Auction Formats, Incentive Pay, Bidding Behavior

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## A STUDY OF ISSUES AFFECTING INTERNATIONAL STUDENTS AT THE GRADUATE SCHOOL OF BUSINESS AND PUBLIC POLICY IN THE NAVAL POSTGRADUATE SCHOOL

**John Sini Porti-Major, Papua New Guinea Defence Force**

**Master of Business Administration-June 2005**

**Hwu Ching-Hwa-Major, Taiwan Army**

**Master of Business Administration-June 2005**

**Piotr Lewandowski-First Lieutenant, Polish Army**

**Master of Business Administration-June 2005**

**Leszek Grabowski-First Lieutenant, Polish Air Force**

**Master of Business Administration-June 2005**

**Advisor: Roxanne Zolin, Graduate School of Business and Public Policy**

**Second Reader: Becky Jones, Graduate School of Business and Public Policy**

The Naval Postgraduate School (NPS) mission is “To provide relevant and unique advanced education and research programs that increase the combat effectiveness of the United States and Allied Forces...”

The goal of this study is to identify issues that affect International Military Students (IMS) at the Graduate School of Business and Public Policy. A total of 42 IMS participated in the study out of a possible 59 students from 51 different countries, including four graduating students, 10 new students and 38 current students.

Issues identified include a lack of information on NPS before coming to Monterey, some students do not select their curriculum, some students have insufficient skills in speaking and writing English, heavy workloads, unfamiliarity with IMS ranks by U.S. students and faculty, and the high cost of living.

**KEYWORDS:** International Military Student, Graduate School of Business and Public Policy, Administrative Issues, Academic Issues, Academic Support Issues, Quality of Life Issues, Grounded Theory, Qualitative Analysis, Quantitative Analysis, Thematic Analysis

## **DEFENSE CO-PRODUCTION: COLLABORATIVE NATIONAL DEFENSE**

**Robert R. Richardson, III-Lieutenant, United States Navy**

**Master of Business Administration-June 2005**

**Advisor: Jerry L. McCaffery, Graduate School of Business and Public Policy**

**Second Reader: Lawrence R. Jones, Graduate School of Business and Public Policy**

This thesis provides an analysis of the co-production of the defense function as provided by the legislative branch, Department of Defense (DoD) and the defense industry at large. The aim of the study is to examine the evolution of the procurement and contracting process since World War II, with a qualitative and quantitative evaluation of the increasingly symbiotic relationship between DoD and corporate America. This relationship has evolved significantly over the last half-century. It is no longer merely transactional, as each side has leveraged the wartime and peacetime interaction to yield upgrades in weapon systems and capabilities that may have been otherwise unattainable in the same timeframe. The benefits of this research include the identification and assessment of the intricacies of the DoD-defense industry relationship, particularly with regard to financial management, and elucidation of significant trends and characteristics that pose potential risk and warrant further study.

**KEYWORDS:** Private Military Companies, Co-Production, Defense Contractors, Outsourcing, Defense Industry

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# MASTER OF BUSINESS ADMINISTRATION

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## UPDATE OF THE NAVY CONTRACT WRITING GUIDE PHASE III

**Brett M. Schwartz-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2005**

**Jadon Lincoln-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2005**

**Jose L. Sanchez-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2005**

**Leslie S. Beltz-Lieutenant, United States Navy  
Master of Business Administration-June 2005**

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**R. Marshall Engelbeck, Graduate School of Business and Public Policy**

**Rene Rendon, Graduate School of Business and Public Policy**

The purpose of this MBA Project is to finalize and complete a comprehensive update of the Navy Contract Writing Guide, which focuses on payment problems and issues throughout the United States Navy. 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 now out of date Guide was originally written in 1996 in an effort to reduce problem disbursements as related to contract wording and organization. The Guide was updated in 2003 and again in 2004 in an effort to provide organization and clear and concise solutions to current contract issues. Extensive research, incorporating interviews and websites, is employed to make the Guide relevant in today's acquisition environment. It is reorganized to address and align with and the best practices of current contracting organizations. It is made more "user friendly" by the use of checklists and hyperlinks to references used throughout the Guide. Additionally, outside research conducted on contract deficiencies (i.e., contract errors) is incorporated into the Guide.

**KEYWORDS:** Contract Writing, Payment Instructions, Problem Disbursements, Deficiency Report, DD-1716, Contract Checklist, Uniform Contract Format, Billing Instructions

## SECURITY AND ECONOMIC DIMENSIONS OF THE TRANSATLANTIC PARTNERSHIP

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**Second Reader: Hans-Eberhard Peters, Department of National Security Affairs**

Transatlantic relations have been on a bumpy ride in recent years, with disagreements over issues ranging from the Iraq War to the Kyoto Treaty, the arms embargo on China and the International Criminal Court. Polemics on "hard" versus "soft" security solutions and "power versus burden sharing" oppose the U.S. option for unilateral action to the European Union's (EU) multilateral cooperation approach.

The parallel enlargement processes in NATO and the EU had a profound impact on one another, given that they both reach the heart of some fundamental questions, ranging from trade liberalization and globalization to the nature of security in 21<sup>st</sup> century Europe. In the new political-economic architecture of Europe, complementary dimensions of security and economic objectives gave way to new tensions between the two shores of the Atlantic.

These matters, however, are only a small part of an otherwise well functioning partnership. The optimal solution is to reach a compromise between the talk of preeminence and unilateralism by the U.S. and the greater willingness by the EU to step up and share the burden.

**KEYWORDS:** Economy, Security, Liberalization, Globalization, Military Power, Burden Sharing, Capabilities, Treaty, Competition, Cooperation, Partnership, Transatlantic Link, Enlargement, Policy, Preeminence, Transformation, Unilateralism

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# MASTER OF BUSINESS ADMINISTRATION

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## A REVIEW OF REVERSE LOGISTICS AND DEPOT LEVEL REPAIRABLE TRACKING IN THE UNITED STATES NAVY

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**Master of Business Administration-June 2005**

**Cane A. Toussaint-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2005**

**Mark A. Edwards-Lieutenant, United States Navy**

**Master of Business Administration-June 2005**

**Advisor: Uday Apte, Graduate School of Business and Public Policy**

**Second Reader: Ira Lewis, Graduate School of Business and Public Policy**

The purpose of this project is to assess how Depot Level Repairables (DLRs) are currently tracked from a not ready for issue (NRFI) material status (i.e., unserviceable) to a ready for issue material status. The Naval Inventory Control Point (NAVICP) conducts more than 380,000 repair actions annually to keep sufficient repair parts available or ready for issue to the fleet upon demand. These repair actions have totaled \$3.08B in shipping and redistribution costs of NRFI materiel. Concentrating on the handling processes of Advanced Traceability and Control (ATAC), this project looks at various aspects of DLR management and current policies. Additionally, authors compare and contrast commercial reverse logistics issues with those of the Navy's retrograde system. The project draws a flowchart of the DLR handling process at its most elementary levels to help the reader more clearly see how changes in the operational environment affect the overall material inventory levels, and more importantly, operational readiness. Finally, the project weighs some options to reduce inventory levels by reducing overall turn-around-time, which may also reduce overall DLR processing costs.

**KEYWORDS:** Depot Level Repairable, DLR, Reverse Logistics, Advanced Traceability and Control, ATAC

## PERFORMANCE BASED BUDGETING: A MODEL FOR THE INDONESIAN DOD

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**B.A., University of Satya Negara Indonesia, 1999**

**Master of Business Administration (Financial Management)-June 2005**

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**Lawrence R. Jones, Graduate School of Business and Public Policy**

A dramatic increase in the past three years in the Indonesian defense budget, from approximately U.S.\$800 million (FY2002\$) in 2002 to approximately U.S.\$ 2.4 billion (FY2005\$) in 2005, has created the need for the Indonesian Department of Defense (DoD) and National Armed Forces (TNI) to enhance performance and accountability for effective and efficient use of state funding. It is imperative that DoD and TNI move to better inform the public and high-level government officials by increasing transparency on how the defense budget is allocated and spent. Current DoD and TNI performance evaluation tools and financial management measurement and reporting methodologies are ineffective, particularly because they do not link performance assessment to the budget and the budget process.

Reform is needed to implement Performance Based Budgeting (PBB) to create direct linkages between allocation of resources in the budget, performance measurement, and strategic planning relative to defense policy objectives so as to bolster public accountability for the DoD and TNI. This thesis analyzes implementation of the Government Performance Results Act of 1993 in the U.S. Federal Government and specifically in the U.S. Department of Defense, to develop a PBB model for the Indonesian DoD/TNI. The thesis addresses critical factors and the steps and processes necessary to create a performance-based budget, including strategic planning, performance measurement and methods to link performance to budgets.

**KEYWORDS:** Performance Based Budgeting, Government Performance Results Act, Performance Measures, Linking Performance to Budget

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# MASTER OF BUSINESS ADMINISTRATION

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## MODEL PROCESS VALIDATION: AN ANALYSIS OF PERFORMANCE-BASED PRICING MODELS

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John E. Mutty, Graduate School of Business and Public Policy  
Keebom Kang, Graduate School of Business and Public Policy**

An objective of the Government Performance and Results Act of 1993 and the President's Management Agenda of 2002 has been to integrate performance measurement with resource allocation (budget) decisions. The Department of the Navy has made the use of performance-based pricing models a central part of their efforts to meet these objectives. Using a comparative case methodology, this thesis examines the three models in the Department of the Navy that have been fully accredited. The formulation of these models, the verification, validation, and accreditation (VV&A) process and their actual use in resource allocation decision making are analyzed against the standards of Navy guidance and industry best practices. In addition to 15 recommendations to strengthen the VV&A process, the research concludes that problems with integration prevent the department from reaching the goal of performance-based budgeting. Improvements can be made in (1) creating conditions to allow the models to better incorporate the effects of Naval transformation, (2) assuring knowledge about these models transfers across organizations and over time, and (3) linking the budget justification material with the justification used for programming decisions.

**KEYWORDS:** Performance-Based Pricing Models, Verification, Validation, and Accreditation, VV&A, Performance-Based Budgeting, Planning, Programming, Budgeting, and Execution, PPBE, Modeling and Simulation, M&S, Performance Measurement

## THE SURFACE WARFARE COMMUNITY'S 360-DEGREE FEEDBACK PILOT PROGRAM: A PRELIMINARY ANALYSIS AND EVALUATION PLAN

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Master of Business Administration-June 2005**

**Advisors: Susan P. Hocevar, Graduate School of Business and Public Policy  
Alice Crawford, Graduate School of Business and Public Policy**

The system known as 360-degree feedback, also called multi-source or multi-rater feedback, is a development program that provides a recipient with feedback from supervisors, peers and subordinates. There is currently no institutionalized, Navy-wide 360-degree feedback program for leadership development. Due to widespread civilian acceptance and to the success of the 360-degree program for the Navy's flag officers, the 2004 Surface Warfare Commanders Conference recommended a pilot program for 360-degree feedback be tested on a portion of the Surface Warfare Officer community. Results of the pilot program will be used to inform decisions on implementation of a Navy-wide 360-degree feedback program. The objectives of this thesis are to review the research evidence in the literature on the effectiveness and best practices of 360-degree programs and to identify general program evaluation techniques. The thesis then presents a conceptual analysis of the Navy pilot program and makes recommendations for modifications to the program based on comparisons with empirical research evidence and identified best practices of 360-degree programs. The thesis concludes by developing some guidelines and recommendations for a program evaluation plan that can be used to assess or revise the pilot program during and after its implementation.

**KEYWORDS:** 360-Degree Feedback, Multi-Source Feedback, Multi-Rater Feedback, Program Evaluation

# MASTER OF BUSINESS ADMINISTRATION

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## AN ANALYSIS OF FACTORS AFFECTING THE RETENTION DESIRES OF SPOUSES OF U.S. NAVY JUNIOR ENLISTED PERSONNEL

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Second Reader: George W. Thomas, Graduate School of Business and Public Policy

This thesis examines factors that influence the retention desires of spouses of U.S. Navy junior enlisted personnel. Data are obtained from the *1999 Survey of Spouses of Active Duty Personnel* on spouses who resided with the military member, and whose significant other was in paygrades E1 to E4 and had between nine months and four years of active duty service. Logistic regression is utilized to measure the influence of various demographic, military and attitudinal variables on a spouse's desire that the significant other stay on active duty. Significant positive influences include the spouse being a member of a race/ethnic group other than white, Hispanic, or black; the service member being an E4 rather than E-1 to E-3; and the spouse's perception that own education opportunities and healthcare benefits are better in military life than in the civilian world. Significant negative influences include the spouse being male, the service member being on sea duty and the number of PCS moves. Further research is recommended to identify policy changes that would influence spouses to more strongly desire that their significant other remain on active duty.

**KEYWORDS:** Navy, Enlisted, Retention, Spouse, Family



# **MASTER OF SCIENCE**

**Aeronautical Engineering**

**Applied Physics**

**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**

**Management**

**Mechanical Engineering**

**Meteorology**

**Meteorology and Physical Oceanography**

**Operations Research**

**Physical Oceanography**

**Space Systems Operations**

**Systems Engineering**

**Systems Technology**



# MASTER OF SCIENCE IN AERONAUTICAL ENGINEERING

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## **TIME-OPTIMIZATION OF HIGH PERFORMANCE COMBAT MANEUVERS**

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**Master of Science in Aeronautical Engineering-June 2005**

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**Isaac M. Ross, Department of Mechanical and Astronautical Engineering**

In this thesis, the authors develop several minimum time air combat maneuvers. Complete aerodynamic models for the HARV and UCAV-X are developed, and different methods of coding data are tested (to include look-up tables and curve-fitting). Thrust vectoring data is included for both aircraft, and a thrust model is developed using GASTURB. Maneuvers are optimized using the MATLAB-based program DIDO, created here at the Naval Postgraduate School. Results for each maneuver are analyzed for both optimality and feasibility, and results are displayed graphically with plots and video clips. Results are compared with those of previous optimal maneuver studies by Komduur and Visser and others. Comparisons are made between the HARV and UCAV-X maneuvers, as well as with current air combat maneuvers.

**KEYWORDS:** ACM, Air Combat Maneuvering, Maneuver Optimization, Minimum Time Maneuvers, Cobra, Herbst, Post-Stall, Thrust Vectoring, F-18, HARV, X-31, DIDO



# MASTER OF SCIENCE IN APPLIED PHYSICS

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## UNDERSEA ACOUSTIC PROPAGATION CHANNEL ESTIMATION

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**Master of Science in Electrical Engineering-June 2005**

**Master of Science in Applied Physics-June 2005**

**Advisors: Joseph A. Rice, Space and Naval Warfare Systems Center-San Diego**

**Roberto Cristi, Department of Electrical and Computer Engineering**

This research concerns the continuing development of Seaweb underwater networking. In this type of wireless network, the radio channel is replaced by an underwater acoustic channel, which is strongly dependent on the physical properties of the ocean medium and its boundaries, the link geometry and the ambient noise. Traditional acoustic communications have involved a priori matching of the signaling parameters (e.g., frequency band, source level, modulation type, coding pulse length) to the expected characteristics of the channel. To achieve more robust communications among the nodes of the acoustic network, as well as high quality of service, it is necessary to develop a type of adaptive modulation in the acoustic network. Part of this process involves estimating the channel scattering function in terms of impulse response, the Doppler effects, and the link margin. That is possible with the use of a known probe signal for analyzing the response of the channel. The estimated channel scattering function can indicate the optimum signaling parameters for the link (adaptive modulation). This approach is also effective for time varying channels, including links between mobile nodes (e.g., two submarines), since the channel characteristics can be updated each time a probe signal is sent.

**KEYWORDS:** Adaptive Modulation, Underwater Communications, Channel Estimation, Acoustic Propagation

## PROPAGATION AND PERFORMANCE ANALYSIS FOR A 915 MHZ WIRELESS IR IMAGE TRANSFER SYSTEM

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**Master of Science in Applied Physics-June 2005**

**Advisor: Richard M. Harkins, Department of Physics**

**Second Reader: Gamani Karunasiri, Department of Physics**

A 915 MHz wireless IR image transfer system, comprised of an IR-160 Thermal Camera and MDS iNet 900 transceivers, was assessed for image transfer capabilities in different environments. Image transfer through natural and artificial obstructions, the capability of transferring images under urban environments, and an exploration of interference issues associated with RF communication links were investigated in detail. Concrete, wood, various construction materials, and building walls were examined to assess indoor propagation capabilities. Data transmission through random trees, buildings, foliage under various atmospheric conditions is also evaluated for outdoor system capabilities. A maximum free space range for acceptable IR image transferring is determined as 23 miles for line of sight (LOS). Non line of sight (NLOS) urban environment measurements revealed that urban path loss (15-60 dBm) is highly dependent on antenna orientation and obstruction geometry rather than the T-R separation distance.

**KEYWORDS:** EM Propagation, Path Loss, Wireless Image Transfer, IR Imaging, Remote Sensing

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## APPLIED PHYSICS

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### **A COUNTERPULSED, SOLID-STATE OPENING SWITCH**

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B.S., United States Naval Academy, 2004  
Master of Science in Applied Physics-June 2005  
Advisors: William B. Maier, II, Department of Physics  
Richard M. Harkins, Department of Physics**

Railguns have great potential in military roles; however, they currently lack a fieldable power supply. Recent advances in the state of low voltage power storage devices may enable practical Pulse Forming Inductive Network power supplies to be developed if a suitable current interruption device is developed. A solid-state device in a counterpulsed opening switch configuration is a possible solution. A demonstration counterpulsed solid-state opening switch is constructed and successfully tested. This circuit consists of Silicon Controlled Rectifier components, which can nominally only turn on current. The counterpulsed configuration allows them to function as opening switches and to do so at much higher currents relative to their specifications. Current interruption at up to 1 kA of peak current is demonstrated. This demonstration system validates the counterpulsing concept and prepares for the construction of a modular 250 kJ system.

**KEYWORDS:** Counterpulsing, Pulse Forming Inductive Network, PFIN, Railgun, Inductive Storage, Solid-State Opening Switch

### **HIGH ENERGY SOLID STATE AND FREE ELECTRON LASER SYSTEMS IN TACTICAL AVIATION**

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B.S., Rensselaer Polytechnic Institute, 1993  
Master of Science in Applied Physics-June 2005  
Advisor: William B. Colson, Department of Physics  
Second Reader: Robert L. Armstead, Department of Physics**

A study and analysis of high energy laser (HEL) systems aboard tactical aircraft is performed. The FA-18E/F Hornet and F-35 Joint Strike Fighter (JSF), equipped with solid-state HEL systems, are the main subjects of the study. Considerations of power generation and thermal management for a fighter-sized HEL system and aero-optic effects on beam propagation from high and medium altitude platforms are examined. An overview of system capabilities details how the HEL system will be more difficult to incorporate into legacy strike aircraft, but may be feasible for future aircraft such as the JSF. Tactical flight simulations are used to study and develop potential concepts of operation (CONOPS), using realistic scenarios and threat environments. Results show that a tactical HEL will not be a stand-alone weapon in combat, but will have many potentially useful tactical applications. Another study of a high energy free electron laser (FEL) system aboard C-130J-30 Hercules shows that such a system is feasible. Finally, a study of the FEL shows that strong field extraction can be optimized using undulator tapering.

**KEYWORDS:** Solid State Laser, Free Electron Laser, Directed Energy, High Energy Laser, Tactical Aircraft, HEL, FEL, SSL, C-130J-30, Joint Strike Fighter, FA-18E/F, Hornet, F-35, Fiber Laser, High Power Laser

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## APPLIED PHYSICS

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### **HIGH ENERGY LASER APPLICATIONS IN A SURFACE COMBATANT: TERMINAL PHASE THEATER BALLISTIC MISSILE DEFENSE, LOW ATMOSPHERE PROPAGATION, AND FREE ELECTRON LASER GAIN**

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**Master of Science in Applied Physics-June 2005**

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**Second Reader: Robert L. Armstead, Department of Physics**

The Free Electron Laser (FEL) can provide the naval surface combatant with a directed energy weapon that can be used against a large target set. Due to space constraints in a shipboard installation, an exploration is conducted to show the feasibility of short Rayleigh length FELs using a FEL simulation. Low atmosphere engagements are discussed through the modeling of a turbulence module for laser propagation in cruise missile defense applications. In particular, this thesis explores the difficulties in engaging a short/medium range theater ballistic missile (TBM) in the terminal phase as an engagement scenario in support of littoral operations using HELCoMES, developed by SAIC, as an engagement analysis tool. A concept of operations (CONOPS) for the use of a FEL as an area TBM defensive weapon is explored, using a unitary, high explosive warhead model and extrapolations to other TBM warhead types.

**KEYWORDS:** Free Electron Laser, FEL, High Energy Laser, HEL, Low Current Gain, Turbulence, Atmospheric Propagation, Thermal Blooming, Theater Ballistic Missile Defense, TMBD, Terminal Phase

### **SIMULATION OF PERFORMANCE OF INFRARED PHOTODETECTORS**

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**Master of Science in Electrical Engineering-June 2005**

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**James Luscombe, Department of Physics**

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**John P. Powers, Department of Electrical and Computer Engineering**

In this thesis, the performance of a step quantum well infrared photodetector, designed by Kevin Lantz (June 2002) and experimentally studied by Michael Touse (September 2003) and Yeo Hwee Tiong (December 2004), is simulated in MATLAB using the transfer matrix method. The results, obtained by the MATLAB program, are compared with the experimental results in an attempt to make inferences about the optimum way of designing QWIP detectors. Simulation of the above implies a numerical solution of the Schrödinger equation, using algorithms and methods, which give accurate results. In this approach, the transfer matrix method (TMM) is used with exponentials and Airy functions to represent the solutions to Schrödinger equation under zero and non-zero bias, respectively. The calculated results are compared with the experimental data and found to provide a good agreement, which validates the accuracy of the model employed. In the final section of the thesis, authors examine and simulate in MATLAB the application of the extended Kalman filtering (EKF) to an infrared photodetector as a target tracking mechanism to both maneuvering and non-maneuvering targets. When one sensor is used for tracking, the results are reliable provided that the target does not maneuver. In the case of a maneuvering target, the results are significantly improved when both sensors are used for tracking.

**KEYWORDS:** Asymmetric Quantum Well, Quantum Well Infrared Photodetector Under Electric Field, Absorption, Probability Current, Transfer Matrix Method, BOT, EKF

### DESIGN OF A PROTOTYPE AUTONOMOUS AMPHIBIOUS WHEGS™ ROBOT FOR SURF-ZONE OPERATIONS

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**Master of Science in Applied Physics-June 2005**

**Advisors: Richard M. Harkins, Department of Physics**

**Ravi Vaidyanahan, Department of Systems Engineering**

The Small Robot Initiative at the Naval Postgraduate School (NPS) has spent several years in development based on the Foster Miller lemmings platform. This platform, in conjunction with a commercial-off-the-shelf (COTS) control architecture, is capable of autonomous, land-based waypoint navigation, self-orientation, and rudimentary obstacle avoidance. It can receive waypoint information, manual control input, and transmit video and audio information back to a control station via 802.11 wireless communications. The introduction of the Whegs™ design, developed at Case Western Reserve University, and a modified version of the COTS control system will provide a platform with greater speed, mobility and versatility. This thesis develops a prototype Whegs™ vehicle and integrates the control system with improvements in the navigation routine through the addition of a dead reckoning sensor and calculation function. Although the mechanical design proves to be highly inefficient and unable to propel itself, the control system is successful, allowing integration with a more robust mechanical design from Case Western Reserve University. Follow on development and research will lighten the body through the use of carbon fiber and test the robots ability to maneuver effectively in the surf-zone.

**KEYWORDS:** Autonomous, Amphibious, Whegs, Robot

# MASTER OF SCIENCE IN APPLIED SCIENCE

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## ANALYSIS OF NEARSHORE CURRENTS NEAR A SUBMARINE CANYON

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Master of Science in Applied Science (Physical Oceanography)-June 2005

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Second Reader: Edward B. Thornton, Department of Oceanography

Accurate prediction of nearshore waves and currents is of critical importance in littoral naval operations. This study examines the effects of complex bathymetry on nearshore currents. Data collected by an array of 12 pressure and velocity sensors in the Nearshore Canyon Experiment (NCEX), conducted near La Jolla, California, in 2003, are analyzed to investigate the variability of nearshore currents near a submarine canyon. Time series of pressure, three-component velocity and wave heights along the 10-meter depth contour are analyzed to determine the relative importance of tides, waves and winds in the forcing of nearshore currents outside the surf zone. Additionally, the spatial variability of the observed currents is investigated in relation to the nearby canyon head. Case studies are examined to determine how different wave and tide conditions affect the currents near the canyon. Conclusions are then made on the effects of bathymetry on nearshore currents. In low-moderate wave conditions, tides dominate longshore currents whereas cross-shore currents show the passage of irregular bore-like features. The currents are coherent away from the submarine canyon and decay towards the canyon head. Strong longshore currents are observed near the canyon head during a large wave event, that were likely driven by an alongshore pressure gradient associated with wave set-up variations.

**KEYWORDS:** Nearshore Canyon Experiment, NCEX, Bathymetry, Scripps Canyon, La Jolla Canyon, Submarine Canyon, Nearshore Currents, Longshore Currents, Tides, Current Prediction

## AN EVALUATION OF YUMA PROVING GROUNDS BALLISTIC ARSENAL SCORING METHODS

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Master of Science in Applied Science (Operations Research)-June 2005

Kristopher E. von Krueger-Ensign, United States Navy

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Master of Science in Applied Science (Operations Research)-June 2005

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Second Reader: Samuel E. Buttrey, Department of Operations Research

Yuma Test Center (YTC) is a primary evaluation and testing facility for the United States Army's 30mm M230 automatic gun. The current program used by YTC to evaluate 30mm rounds is an outdated, complex, LINUX-based package called Accuracy Scoring Program (ASCORE). Due to the age and complexity of ASCORE, questions on its reliability in ballistic calculations have been raised. These reliability questions are important to the Army because ASCORE is used to evaluate and pass weapons systems to Department of Defense specifications. Currently, there are no planned replacements for the Army to replace ASCORE. The Navy has also expressed interest in using ASCORE to reevaluate its own weapons systems. In this research, authors evaluate ASCORE by using a modern ballistic simulator, the Projectile Design and Analysis System (PRODAS), to create many known round trajectories and to evaluate how well ASCORE matches these known trajectories. A model is fit based on these trajectories. The model can be used to help decide how different these two simulators are from each other.

**KEYWORDS:** Virtual Target, ASCORE, PRODAS, Ballistic Trajectory

**TESTING THE HG1700 INERTIAL MEASUREMENT UNIT FOR IMPLEMENTATION INTO  
THE *ARIES* UNMANNED UNDERWATER VEHICLE**

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**B.S., United States Naval Academy, 2004**

**Master of Science in Applied Science-June 2005**

**Advisor: Anthony J. Healey, Department of Mechanical and Astronautical Engineering**

**Second Reader: Edward B. Thornton, Department of Oceanography**

The *ARIES* Unmanned Underwater Vehicle (UUV) currently uses an Inertial Measurement Unit (IMU) with an inherent rotation rate error bias of 10 degrees/hour. The need for a more accurate IMU for long-term missions has led to the purchase of the Honeywell HG1700 IMU. The HG1700 is a ring laser gyroscope designed specifically as part of the navigation software in multiple U.S. missiles. The objective of this research is to perform numerous bench tests on the HG1700 to test its capabilities and to begin the process of implementing the IMU into the *ARIES* unmanned underwater vehicle. Specifically, the IMU is tested for correct setup configurations, angle of rotation accuracies, the rotation rate error bias, and positional accuracies. Also, guidelines for integrating the IMU with the current software in the *ARIES* vehicle are discussed.

**KEYWORDS:** Inertial Measurement Unit, Unmanned Underwater Vehicle, *ARIES* Vehicle

**BREAKING WAVE TURBULENCE IN THE SURF ZONE**

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**Master of Science in Applied Science (Physical Oceanography)-June 2005**

**Advisor: Timothy P. Stanton, Department of Oceanography**

**Second Reader: Edward B. Thornton, Department of Oceanography**

The surf zone is an increasingly exercised and precarious region of the maritime battlefield. Information on wave properties and turbulence dissipation from breaking waves in the surf zone is obtained from data collected during the 2001 RIPEX/ Steep Beach Experiment. Wave characteristics, such as current velocities, period, significant wave and sea surface height and tide are examined. The tide is shown to have a major influence on the breadth and location of the surf zone from the shoreline. Video imaging time series are geometrically transformed into plan views of pixel brightness related to wave breaking intensity. Surf zone boundaries are generated using both a computer algorithm and manual manipulation.

Two methods are examined for calculating breaking wave dissipation rates for particularly robust days (110.5 -114.5). Velocity data are acquired using two electromagnetic current meters on the vertical mounted tower in mid-surf zone. The first method identifies individual bores which are ensemble averaged by phase over 30-minute records to obtain wave number spectra invoking Taylor's frozen turbulence hypothesis. The second method uses 30-minute ensemble average spectra to obtain dissipation after Trowbridge and Elgar (2001). Dissipation rates calculated underneath each bore segment are orders of magnitude smaller when compared to the ensemble averaged technique. Dissipation rates underneath the bore cycle are shown to lag behind the sea surface elevation and current velocity to decrease under bore peaks.

**KEYWORDS:** Surf Zone, Turbulence, Dissipation Rate, Breaking Waves, Image Intensity

## **SUBTIDAL VARIABILITY IN THE NORTHERN SOUTH CHINA SEA DURING SPRING 2001**

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**B.S., United States Naval Academy, 2004**

**Master of Science in Applied Science-June 2005**

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**Second Reader: Leslie K. Rosenfeld, Department of Oceanography**

The Asian Seas International Acoustics Experiment (ASIAEX) conducted in April and May of 2001 helped researchers take a major step in understanding the circulation of the northern South China Sea. This region crosses one of the primary sea lanes of communication between Chinese submarine bases and the Pacific theater, therefore making it an extremely valuable source of knowledge for the United States Navy. This thesis provides a qualitative and quantitative analysis of the mesoscale variability in the South China Sea during spring 2001 using observational data from the ASIAEX experiment.

An array of moorings (S1-S8) equipped with ADCPs, pressure gauges, temperature and salinity sensors, and current meters, was placed between the southern tip of Taiwan and Dongsha Island (Pratis Reef). Data results show that significant mesoscale features existed in the South China Sea. Mean currents over the continental shelf were found to be primarily wind driven while flows over the continental slope were forced by the mesoscale features. The South China Sea Warm Current was observed twice over the slope during ASIAEX. A cyclonic meander of the northern gyre propagated onshore and southwest near S7. Tropical Cyclone Cimaron set up a pressure driven flow towards the southwest along the continental shelf, suggesting that a storm this size can influence the circulation in the entire South China Sea.

Model results from the northern South China Sea Nowcast/Forecast System are compared to the observational data. The model gives a good description of the big picture in the South China Sea but is unable to resolve the smaller-scale events. The model is too constrained by topography and has a distinct offset of the alongshore component most likely imposed on by open boundary forcing.

**KEYWORDS:** South China Sea, Asian Seas International Acoustics Experiment, ASIAEX, Subtidal Variability



# MASTER OF SCIENCE IN ASTRONAUTICAL ENGINEERING

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## DEVELOPMENT OF LOW COST SATELLITE CONTROL SOFTWARE

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**Master of Science in Astronautical Engineering-June 2005**

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**Second Reader: Isaac M. Ross, Department of Mechanical and Astronautical Engineering**

This thesis details the development and validation procedures of the experiment control software to be used on the NPSAT1. The software is developed for a standard Linux kernel using freely available programming tools instead of expensive proprietary software development tools. The software developed includes functions for satellite orbit prediction, precise satellite location and adaptive, interactive scheduling. Inputs from the electrical power system, sub-satellite position and sub-satellite local time are used to develop schedule queues automatically.

**KEYWORDS:** Satellite, Control Software, Command and Data Handling, C&DH, Orbit Propagation, NPSAT, Linux



# MASTER OF SCIENCE IN COMPUTER SCIENCE

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## IPSEC-BASED DYNAMIC SECURITY SERVICES FOR THE MYSEA ENVIRONMENT

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It is recognized that security services in information-processing systems require access to finite resources in the execution of their duties. In response to the changing threats faced by a system and/or the availability of system resources, it is desired that the system be able to adjust its operational security policies automatically while continuing to function under an acceptable global security policy.

This work involves the analysis and integration of a dynamic security service (DSS)-enabled IPsec implementation into a form ready for installation into the MYSEA environment. The feasibility of dynamic security services is demonstrated with support for secrecy and/or integrity protection of MLS server-to-end-user communication via a Trusted Path Extension. This is accomplished through the modulation of the IPsec security associations to adapt to operational needs.

The result of this research is beneficial to Homeland Security, the Department of Defense and the intelligence community by enabling remote distributed computing clients to operate in a secure manner that remains flexible to adapt to changing requirements of protection on the network and the availability of resources on terminating hosts. Furthermore, these methods can aid the realization of high-assurance edge-client connectivity in the creation and extension of the Global Information Grid (GIG).

**KEYWORDS:** Information Assurance, Multilevel Security, Dynamic Security, Monterey Security Architecture, IPsec, ISAKMP, IKE, KeyNote

## AUTOMATIC TEST CASE GENERATION FOR REACTIVE SOFTWARE SYSTEMS BASED ON ENVIRONMENT MODELS

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**Master of Science in Computer Science-June 2005**

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**James Bret Michael, Department of Computer Science**

The goal of software testing is to expose as many faults as possible. Often one can increase the number of faults detected by running large amounts of test cases. Therefore, the ability to automatically generate applicable test cases for a System Under Test (SUT) would be a valuable tool. In this thesis, an attributed event grammar is designed and used to build a model that describes the environment an SUT must operate in. This event grammar captures events, their precedence or inclusion relation to other events and attributes of the events. An event is defined as an observable action that has a distinct beginning and end. The high level environment model is then used by a test generator to produce an event trace from which input for the SUT is extracted. Thousands of event traces can be generated. For reactive systems the event trace will have the appropriate time delays between inputs. The feasibility of this approach is proven by implementing a prototype of an automated test generator based on environment models

**KEYWORDS:** Automatic Test Case Generation, Attributed Event Grammar, Event Trace, Event Grammar, Software Testing, Testing Automation, Test Generation, Real-Time Systems

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# COMPUTER SCIENCE

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## WEB-BASED DISSEMINATION SYSTEM FOR THE TRUSTED COMPUTING EXEMPLAR PROJECT

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**Master of Science in Computer Science-June 2005**

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**Thuy D. Nguyen, Department of Computer Science**

Open dissemination of the Trusted Computing Exemplar (TCX) project is needed. This dissemination must include methods to provide secure web access to project material, integrity verification of data and group-based access controls. Because previously developed dissemination systems do not meet these requirements, a hybrid web-based dissemination system is necessary.

The development of the TCX Dissemination System requirements involves the analysis of assumptions, threats, policies and security objectives for the system and its environment based on the Common Criteria methodology. The requirements yield a design specification that includes a dissemination application that uses XML capabilities for redaction and preparation of releasable materials. This leads to the creation of an initial implementation to satisfy a subset of the TCX dissemination requirements. Future work is identified for a subsequent implementation that fulfills additional project requirements.

The complete implementation of the dissemination environment described in this thesis will provide a seamless dissemination interface for the TCX project. The Dissemination System provides an example of how controlled information can be organized and made available on the web. When combined with TCX project results, it supports the assured information sharing objectives of the Department of Defense Global Information Grid vision.

**KEYWORDS:** Trusted Computing Exemplar, Web-Based Dissemination System, Common Criteria, Secure Delivery, XML-Based Access Control, Document Redaction

## AN EVALUATION OF TWO HOST-BASED INTRUSION PREVENTION SYSTEMS

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**J.D. Fulp, Department of Computer Science**

Host-based intrusion-prevention systems are recently popular technologies that protect computer systems from malicious attacks. Instead of merely detecting exploits, the systems attempt to prevent the exploits from succeeding on the host they protect. This research explores the threats that have led to the development of these systems and the techniques many use to counter those problems. Two current intrusion-prevention products (McAfee Enterccept and the Cisco Security Agent) are evaluated as to their success in preventing exploits. The tests used live viruses, worms, Trojan horses, and remote exploits, which were turned loose on an isolated two-computer network. Recommendations are provided regarding deployment of the two products. Recommendations are based on the results of testing performed by the authors.

**KEYWORDS:** Host-Based Intrusion Prevention, McAfee Enterccept, Cisco Security Agent, Penetration Testing

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## COMPUTER SCIENCE

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### **A COMPLEX ADAPTIVE SYSTEM APPROACH TO FORECASTING HURRICANE TRACKS**

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**Master of Science in Computer Science-June 2005**

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**Second Reader: Patrick A. Harr, Department of Meteorology**

Forecast hurricane tracks using a multi-model ensemble that is comprised by linearly combining the individual model forecasts have greatly reduced the average forecast errors when compared to individual dynamic model forecast errors. In this experiment, a complex adaptive system, the Tropical Agent Forecaster (TAF), is created to fashion a “smart” ensemble forecast. The TAF uses autonomous agents to assess the historical performance of individual models and model combinations, called predictors, and weights them based on their average error compared to the best track information. Agents continually monitor themselves and determine which predictors, for the life of the storm, perform the best in terms of the distance between forecast and best-track positions. A TAF forecast is developed using a linear combination of the highest weighted predictors. When applied to the 2004 Atlantic hurricane season, the TAF system, with a requirement to contain a minimum of three predictors, consistently outperforms, although not statistically significant, the CONU forecast at 72 and 96 hours for a homogeneous data set. At 120 hours, the TAF system significantly decreases the average forecast errors when compared to the CONU. The multi-agent (MAS) system approach opens the door for statistically significant forecast improvement.

**KEYWORDS:** Tropical Cyclones, Hurricanes, Complex Adaptive System, Multi-Model Ensemble, Multi-Agent Systems

### **ROLE-BASED ACCESS CONTROL FOR COALITION PARTNERS IN MARITIME DOMAIN AWARENESS**

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**Master of Science in Computer Science-September 2005**

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The need for Shared Situational Awareness (SSA) among coalition militaries, law enforcement, the intelligence community, and the private sector creates a unique challenge to providing access control. In this thesis, authors investigate the capabilities and limitations of Role-Based Access Control (RBAC) to control the dissemination of SSA in a coalition environment. The case study used is that of controlling access to SSA in the Maritime Domain Awareness (MDA) environment. MDA exemplifies both rapid change in membership of coalitions and the roles of coalition participants. The access policy and roles played by the participants in the MDA environment are explored, in addition to the characteristics of those roles. Authors make use of feasible scenarios to provide a base for applying models to the situation. The models that are applied to the scenario provide the formal methods that prove that RBAC policies and derivatives, such as Distributed Role Based Access Control (DRBAC), Coalition Based Access Control (CBAC) and Temporal Role Based Access Control (TRBAC), can be used in conjunction with the Information Broker (IB) concept to provide adequate access control policies.

**KEYWORDS:** System-of-Systems, Dependable Systems, Trustworthy Systems, Architecture, Distributed Computing, Real-Time Systems, Component-Based Software Engineering, Kernel, Formal Methods, Assertions, Model Checking



# MASTER OF SCIENCE IN CONTRACT MANAGEMENT

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**AN ANALYSIS OF OTHER TRANSACTIONS. HAVE OTHER TRANSACTIONS MET THE  
INTENT OF CONGRESS?**

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**Master of Science in Contract Management-June 2005**

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**Second Reader: E. Cory Yoder, Graduate School of Business and Public Policy**

Department of Defense (DoD) Science and Technology (S&T) programs seek and need the best research and technology, most of which serves the needs of the commercial marketplace. DoD had limited access to these non-traditional performers because many would not accept the onerous requirements imposed by contracts issued under the rules of Federal Acquisition Regulations. In 1989, Congress provided "Other Transaction Authority" (OTA) to address this problem. OTA provided a procurement vehicle that minimized the laws and regulations applicable to contracts, grants or cooperative agreements. This study examines all DoD reports submitted to Congress detailing Cooperative Agreement and "Other Transaction" awards for fiscal years 1997-2003 to determine the extent to which the objectives of the OTA legislation were achieved. The researcher finds that only 11 percent of the awards went directly to "non-traditional" contractors, the remaining 89 percent going to traditional defense contractors. Only one-tenth of one percent of all DoD "Research, Development, Test and Evaluation" funding in those fiscal years, awarded in the form of cooperative agreements or "other transactions," went directly to "non-traditional" contractors. Thus, OTA has proved ineffective at attracting "non-traditional" contractors to DoD S&T projects.

**KEYWORDS:** Other Transactions, Cooperative Agreements, Other Transaction Authority, Section 845, Contract Authority



# MASTER OF SCIENCE IN DEFENSE ANALYSIS

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## **INFORMATION SHARING ABOUT INTERNATIONAL TERRORISM IN LATIN AMERICA**

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Advisor: Hy S. Rothstein, Department of Defense Analysis  
Second Reader: Kalev Sepp, Department of Defense Analysis  
Third Reader: Frank Giordano, Department of Defense Analysis**

The purpose of the thesis is to analyze the importance of sharing information when dealing with activities related to international terrorism in Latin America, especially in the aftermath of the terrorist events against the United States on September 11, 2001. The importance of information on international terrorism is critical in the war against terrorism, particularly in this region, due to the potential for those activities associated with the already existent organized crime. The importance of information includes organizations. Therefore, the proposed organizational process makes it possible to facilitate the sharing of information considering the complexity involved. At the same time, the necessity of information about the threat of terrorism can be demonstrated through the use of game theory. This model can drive the states to use all means necessary to obtain relevant information. The requirement for information sharing must be solved based on the relevance of the threats and the need for increased security for the states in the region.

**KEYWORDS:** International Terrorism, Information International Crime, Threats, International Organizations, Sharing Information, Latin America

## **RUSSIAN STANCE IN THE CAUCASUS AND THE NATIONAL SECURITY STRATEGY OF GEORGIA**

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Master of Science in Defense Analysis-June 2005  
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Second Reader: Douglas Borer, Department of Defense Analysis**

After the independence of Georgia, declared in 1991, Moscow's strategic stance in the Caucasus has been heavily influencing the formation of the Georgian State, and has created many problems to its security. Three separatist regimes supported by Moscow, Russian bases in Georgia, and Georgia's significant economic dependence on Russian energy markets were the most visible components of this influence. Russian negative influence on Georgia's security, in combination with many apparent internal problems, determined that during 14 years of independence, Georgia became a failed state.

After the "Rose Revolution" of 2003, this situation changed and Georgia started to develop policies relatively independent from Moscow's strategic preferences.

This thesis tries to define the possible objectives, strategies and means of the Georgian state to achieve its final independence from Russia, exercise its sovereignty on its entire territory and provide conditions for the prosperous development of the country and its population. The thesis examines global trends and local developments that influence Georgia's security, and suggests recommendations for the Georgian government.

**KEYWORDS:** Georgia, Russia, National Security, Strategy, Separatism, Abkhazia, South Ossetia, GUUAM, Caucasus, Caspian Sea

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## DEFENSE ANALYSIS

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### **MAXIMIZING THE INTER-SERVICE SPECIAL OPERATIONS FORCES HANDSHAKE**

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**Edward D. Eldridge-Captain, United States Army  
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U.S. Army Special Forces (SF) and the Naval Special Warfare (NSW) forces conduct numerous training missions within South America in support of SOCSOUTH's strategy. Additionally, the two services routinely conduct similar missions with similar Host Nation (HN) forces. Historically, Army SF and NSW have lacked a strong operational "handshake" when transitions occur between these HN units. Often, the results are redundant training with HN forces, lack of overall training continuity, a high expenditure for the results obtained and an inability to more rapidly progress forward with HN training.

The lack of inter-service communication between the Army SF and the NSW forces becomes more significant when the number of SOF available in the area of operation (AOR) is reduced. By addressing these key issues through more efficient inter-service communication, the present forces can more adequately respond to the current and future threats in the AOR. This thesis presents ideas that may help curtail excessive spending while increasing the ability of the two Special Forces service components, SF and NSW, to collectively work together with a greater understanding of each other's capabilities and mission directives.

This thesis investigates several factors that affect the efficiency of U.S. forces conducting training with HN countries throughout South America, and focuses specifically on the troubled areas of Colombia and the tri-border region of Paraguay, Brazil and Argentina, and their political, economic and demographic uniqueness. It also evaluates how Special Operations Forces should be and are currently employed in Operation Iraqi Freedom, their strategic utility and overall effectiveness. Through analyzing these factors, the thesis identifies key elements that contribute to the effectiveness of the Special Operations Forces tasked with working throughout South America, and refocuses on the operational requirements, specifically informational reporting and dissemination, which could better facilitate an inter-service handshake.

**KEYWORDS:** HN, Colombia, TBA, NSW, SF, South America, GWOT

### **ANALYSIS OF COMMUNIST VIETNAMESE SPECIAL OPERATIONS FORCES DURING THE VIETNAM WAR AND THE LESSONS THAT CAN BE APPLIED TO CURRENT AND FUTURE U.S. MILITARY OPERATIONS**

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**Master of Science in Defense Analysis-June 2005**

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**Second Reader: Kaley Sepp, Department of Defense Analysis**

This thesis examines the role of communist special operations forces during the Vietnam War and the relevancy of the lessons learned from these units. The United States military, specifically Army Special Forces, Rangers and Navy SEALs, were not the only forces capable of conducting successful special operations during the conflict. The People's Army of Vietnam also had a highly organized, well-trained and well-equipped organization capable of carrying out special operations. This organization was the sapper arm, and it was composed of three separate types of units. The Urban Sapper was concerned with intelligence gathering, terrorism, assassination and special operations in the large urban areas such as Saigon and Hue. The Naval Sapper was responsible for attacking shipping, bridges and bases located near waterways. The Field Sapper conducted operations against deployed U.S. and South Vietnamese troops, trained other communist troops as sappers and gave the communist leadership an elite force for lightning raids. The sapper force had certain operational principles, organizational constructs and functional methods that set it apart from any other communist military element used during the Vietnam War.

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## **DEFENSE ANALYSIS**

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**KEYWORDS:** Vietnam, Sapper, Commando, PAVN, Special Operations Force

### **THE PRINCIPLES OF WAR: ARE THEY STILL APPLICABLE?**

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**Second Reader: George W. Lober, Department of Defense Analysis**

The purpose of this thesis is to examine the principles of war as derived from the teachings of Baron Antoine Henri de Jomini and to analyze them in terms of their continued applicability. This thesis looks at the complex nature of conflict in the 21<sup>st</sup> century, as well as the rise of unconventional warfare in recent years, and how significant changes in the overall realm of combat may be diminishing the relative importance of the nine principles of war utilized by the United States military for almost two centuries. The main objective of this study is to determine whether the traditionally accepted principles of war have become less applicable, and if so, to recommend new principles that could potentially be more appropriate for U.S. forces when developing new doctrine, strategy, tactics and organizational structures.

This study utilizes a heuristic approach in which the nine principles of war currently utilized by the United States military are projected through the lens of unconventional warfare in such a way as to consider whether these principles are no longer suitable for use when facing complex, innovative adversaries, such as globally networked, non-state sponsored, terrorist organizations and/or rogue states. Upon demonstrating the diminished applicability of some of the nine principles of war still in use, this study then identifies and defines several new principles that should be considered more relevant to the changing conditions and circumstances of conflict.

Finally, a discussion of principles of war as formulated by Sun Tzu provides a basis on which to compare and contrast Jomini's teachings with that of another great military thinker whose notions regarding the art of warfare may provide a more suitable paradigm upon which to construct a new version of the modern principles of war.

**KEYWORDS:** Principles of War, Modern Principles of War, Jomini, Unconventional Warfare, Modern Warfare, Future War, Sun Tzu, The Art of War

### **RETHINKING GLOBAL ENGAGEMENT - THE REQUIREMENT FOR KNOWLEDGE BEFORE ACTION**

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The type of engagement necessary for U.S. security is not compatible with the interests of today's U.S. Special Operations Forces (SOF). America requires a Global Engagement Plan (GEP) that is unprecedented in its patience and persistence, and that maintains a diffuse presence everywhere on the planet. Such a plan envisions and necessitates deliberate, intimate and continuous American contact with the predominantly non-elite majority that is inadequately observed and reported on by extant instruments of American power. Operatives tasked with executing the GEP would be permanently immersed in the host environment, taking a U.S. Army Special Forces (SF) mantra to "operate by, with, and through indigenous forces and peoples" to an extreme. Current American governmental structures and methods of foreign engagement are unequal to such a task. America already has a force whose mission includes acting as "global scouts": Special Forces. Nevertheless, the traditional method of SF employment is inadequate to provide such continuous observation and reporting. Better methods of global engagement can be found in both a (military) Regional Engagement Concept (REC), and a proposed Global Engagement Agency within the Department of State for (civilian) operatives. Retired and/or transitioned SF soldiers provide an ideal nucleus for the forming of such an agency.

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## DEFENSE ANALYSIS

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**KEYWORDS:** Rethinking Global Engagement, Requirement for Knowledge Before Action

### **TRANSFORMING THE AMERICAN SOLDIER: EDUCATING THE WARRIOR-DIPLOMAT**

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**Steven A. Warman-Major, United States Army**

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**Second Reader: Glenn E. Robinson, Department of Defense Analysis**

In this thesis, authors examine the current levels of cultural understanding and irregular warfare being taught in U.S. Army conventional military schools. Given engagements in Iraq and Afghanistan, it is the authors' view that the military needs a deeper understanding of the indigenous people due to the extremely close and on-going interaction between American soldiers and the local populations. Current analysis of the difficulties being reported suggests that U.S. Army soldiers are having trouble combating irregular warfare due to cultural misunderstandings and a lack of counter-insurgency training, thereby reflecting a likely educational gap in the U.S. Army's formal military educational training system.

Authors examine the current problems and difficulties soldiers are reported to be having while attempting to combat irregular forces in non-western environments. The amount of training U.S. Army soldiers receive in cultural understanding and irregular warfare in the military schools pipeline is analyzed, and authors conclude that there is a connection between problems soldiers currently face and a lack of training for the conduct of operations in foreign countries. A number of solutions to overcome these suspected gaps in education are proposed and recommendations are made regarding changes to the Army's professional education curriculum.

**KEYWORDS:** Irregular Warfare, Cultural Awareness, Military Education, Military Training, Counterinsurgency

### **FOURTH GENERATION WAR: PARADIGM FOR CHANGE**

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This thesis argues that a shift in the doctrine, organization, equipment and training of armies is required due to a shift in the nature of war. This thesis refers to the "new way of war" as Fourth Generation War (4GW) and this analysis is restricted to the army component of the defense forces. Armies at present are geared to fight the earlier generation of attrition and maneuver wars. In 4GW, an army structured for earlier generations of warfare is militarily dysfunctional. The thesis statement is that infantry-based armies practicing unconventional warfare (UW) are essential for the 4GW battlefield. The thesis argues for the conventionalization of UW. Hypothesis One states that heavy armor/artillery based armies should give way to infantry based armies. Hypothesis Two states that the military doctrine of these infantry based armies should be based on UW. The thesis explains 4GW and examines the relationship between terrorism and 4GW. It studies the impact of 4GW on the Principles of War. It examines whether Special Forces (SF) are the panacea for 4GW and whether increasing the size of SF is the solution. Lastly, the thesis discusses the changes required in the army to fight in a 4GW environment and provides recommendations.

**KEYWORDS:** Fourth Generation War, 4GW, Principles of War, Special Operations Forces, Special Forces, Asymmetric War, Limits of Organizational Size

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## **DEFENSE ANALYSIS**

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### **ISLAMIC INSURGENCY AND TRANSNATIONAL TERRORISM IN THAILAND: ANALYSIS AND RECOMMENDED SOLUTION STRATEGY**

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**Second Reader: Frank Giordano, Department of Defense Analysis**

The Kingdom of Thailand currently faces internal and transnational Islamic insurgent threats that have the potential to disrupt Southeast Asian regional stability. As a major non-NATO ally and the signatory of several bilateral and multilateral security arrangements with the U.S., Thailand has solidified itself as a security alliance partner whose stability and influence in Southeast Asia has become increasingly more important to the U.S. and its War on Terror.

The purpose of this thesis is to provide a history and analysis of the Islamic insurgency and transnational terrorist operations that exist in Thailand today. This thesis also highlights current Thai, U.S. and regional security initiatives and underscores policy deficiencies. Finally, this thesis recommends a solution strategy necessary for the purge of radical Islamic insurgency and transnational terrorism in Thailand. By accepting current policy deficiencies and implementing the courses of action recommended in this thesis, the U.S. and Thailand will both contribute to a greater Southeast Asian security.

**KEYWORDS:** Insurgency, Counterinsurgency, Islamic Fundamentalism, Muslim Separatism, Transnational Terrorism, Terrorism, Counterterrorism, Thailand

### **MANHUNTING: A METHODOLOGY FOR FINDING FUGITIVES OF NATIONAL INTEREST**

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**Thomas M. Meer-Captain, United States Air Force**

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**Anna Simons, Department of Defense Analysis**

The asymmetrical threats that challenge U.S. national policies are not large standing armies, but rather individuals who seek to usurp and coerce U.S. national interests. The nature of today's threats call for the U.S. military to change from finding, fixing, and destroying the enemy's forces to identifying, locating and capturing rogue individuals in order to destroy networks. To counter such threats, the U.S. Government (USG) will have to quickly and efficiently identify and find these targets globally.

Unfortunately, no military doctrine, framework or process currently exists for finding and apprehending these Persons of National Interest (PONIs). Since military planners and intelligence analysts are neither educated nor trained in the methods or procedures necessary to find and capture PONIs, this thesis proposes a methodology to do so. This involves the development of an analytical process, and an organizational structure and procedure to identify and locate PONIs. Consequently, the United States government's ability to prosecute the war on terrorism today, and to find and apprehend PONIs in the future, depends on its ability to develop and institutionalize a comprehensive manhunting strategy now.

**KEYWORDS:** Fugitives, Manhunting, Manhunts, Terrorism, Military Operations Other Than War, MOOTW, Investigative Process, Counter-Leadership Operations, CLO, High Value Targets, Information Collection, Deception and Denial, Personnel Targeting Operations, PTO

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## **DEFENSE ANALYSIS**

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### **THE BRITISH IN KENYA (1952-1960): ANALYSIS OF A SUCCESSFUL COUNTERINSURGENCY CAMPAIGN**

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Following WWII the British Government was reducing its colonies due to rebuilding costs and a waning interest in costly overseas colonies. During this time there were approximately 30,000 white settlers living in Kenya with nearly five million Kikuyu and Masai. Unrest had been building in this area long before the 1950s due to the Briton's perceived lack of interest in the well being of the native populations. Coupled with the recently implemented apartheid movement in South Africa, many natives felt this was the path down which Kenya was headed.

By 1952 it was obvious to the British government that there was great unrest among the Kikuyu population in Kenya. Similar to the Malayan Emergency, the British had been caught off guard and failed to recognize the scale of the threat Mau Mau posed.

On 20 October 1952, a state of emergency was declared in Kenya. Throughout the following eight years several programs were implemented by the British to return the colony to a state of normalcy including widespread detention, compulsory registration of Kikuyu, livestock seizure, taxes for the additional cost of the insurgency, re-education measures, the use of reformed Mau Mau and local troops to combat the insurgency and eventually, the capture and execution of Mau Mau leader Dedan Kimathi in 1956. The declared state of emergency would remain in effect, however, until 1960.

**KEYWORDS:** Mau Mau, Kenya, Counterinsurgency, Colonialism, Kikuyu

### **ENHANCING NATIONAL SECURITY IN JAMAICA THROUGH THE DEVELOPMENT AND EMPLOYMENT OF SPECIAL OPERATIONS FORCES**

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**Second Reader: George W. Lober, Department of Defense Analysis**

While Special Operations Forces are commonly identified with the pursuit of foreign policy, they may also be used in the domestic security infrastructure. Given the long-practiced use of the military in developing countries in internal security roles (inclusive of Jamaica), and given the rise to prominence of transnational threats over traditional threats in Jamaica, a need has arisen for an evolution in the military to adequately meet these new, unconventional threats. Such a capability may be embodied in a Special Operations Force properly selected, trained, equipped and organized to mitigate the irregular threats, such as terrorism, illicit arms and narcotics trafficking, and organized crime, which currently face Jamaica. This study examines the value, utility and possible roles of such a unit in the Jamaican security landscape, and makes recommendations for the establishment and employment of such a unit in Jamaica.

**KEYWORDS:** National Security, Special Forces, Employment, Special Operations, Conventional Operations

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## DEFENSE ANALYSIS

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**UNCONVENTIONAL DETERRENCE STRATEGY**  
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**Master of Science in Defense Analysis-June 2005**  
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This thesis examines a largely unexplored area of deterrence theory – unconventional deterrence. Unconventional deterrence is defined herein as “persuading the opponent not to attack, via threats of unconventional warfare, such as guerrilla resistance and terrorism.” It treats terrorism as a punishment strategy, through which the one deterring threatens to punish the aggressor’s population. Guerrilla warfare is a denial strategy, through which the one deterring threatens to protract a war and deny the aggressor his political objectives. This study questions the underlying hypothesis of deterrence theory, which says that the balance of the opponents’ military capabilities is the basic determinant of successful deterrence. Rather, the hypothesis here is that the deterrer may deter the aggressor from attacking by adopting a strategy that makes the aggressor’s military superiority irrelevant. The present thesis focuses primarily on relatively weak states. Unconventional deterrence is explored as a means for a weaker state to deter a considerably stronger opponent.

This thesis discusses the requirements for successful deterrence, and the peculiarities of unconventional deterrence. The dynamics of small wars are explored in order to unfold a paradoxical phenomenon: the possibility of an underdog’s victory in war. Two cases are studied: the Vietnam War of 1964-73 and the Afghanistan War of 1979-89. These cases are explored as examples of the weak denying the strong their objectives.

**KEYWORDS:** Deterrence, Unconventional Deterrence, Denial, Punishment, Unconventional Warfare, Guerrilla Warfare, Terrorism, Small Wars, Afghanistan, Vietnam



# MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

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## **PERFORMANCE ANALYSIS OF 802.16A**

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With the ever-increasing popularity of wireless Internet, its scale is broadening. While the IEEE 802.15 standard provides the parameters necessary for a wireless personal area network (WPAN), the IEEE 802.16a standard provides broadband wireless access (BWA) or a wireless metropolitan area network (WMAN). Popularly referred to as Wi-Max, the standard uses cellular topography with a base station and subscriber station and cuts down on infrastructure and thus can be used in most environments. The 802.16a standard can take advantage of the popular OFDM modulation technique. This thesis takes a developed synchronization algorithm and tests its performance on 802.16a. In addition, it tests the standard's performance in different types of channels. Various techniques are evaluated, including interleaving and antenna diversity. The 802.16a standard employs a form of transmit diversity called Space-Time Coding. The transmit diversity is compared with Maximal-Ratio Combining receiver diversity. The evaluation is conducted in simulations developed in MATLAB; the simulations show drastic improvement when using the aforementioned techniques, particularly diversity.

**KEYWORDS:** IEEE 802.16a, WPAN, WMAN, OFDM, Space-Time Coding, Maximal Ratio Combining

## **FOCUSING INVERSE SYNTHETIC APERTURE RADAR (ISAR) IMAGES USING FAST ADAPTIVE TIME-FREQUENCY AND 3D MOTION DETECTION ON SIMULATED AND EXPERIMENTAL RADAR DATA**

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**Thayananthan Thayaparan, Defence Research and Development Ottawa-Canada**

**Second Reader: Jeffrey B. Knorr, Department of Electrical and Computer Engineering**

Optimization algorithms are developed for use with the Adaptive Joint Time-Frequency (AJTF) algorithm to reduce Inverse Synthetic Aperture Radar (ISAR) image blurring caused by higher-order target motion. A specific optimization is then applied to 3D motion detection. Evolutionary search methods based on the Genetic Algorithm (GA) and the Particle Swarm Optimization (PSO) algorithm are designed to rapidly traverse the solution space in order to find the parameters that would bring the ISAR image into focus in the cross-range. Three-dimensional motion detection is achieved by using the AJTF PSO to extract the phases of three different point scatterers in the target data, and measuring their linearity when compared to an ideal phase for the imaging interval under investigation. The algorithms are tested against both simulated and real ISAR data sets.

**KEYWORDS:** Inverse Synthetic Aperture Radar, Adaptive Joint Time-Frequency Algorithm, Genetic Algorithm, Particle Swarm Optimization, 3D Motion Detection, ISAR, AJTF, GA, PSO

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# ELECTRICAL ENGINEERING

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## DETECTION OF FREQUENCY-HOPPED SIGNALS EMBEDDED IN INTERFERENCE WAVEFORMS

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Many military communications systems utilize frequency-hopped spread spectrum waveforms to protect against jamming and enemy detection. These waveforms may be subjected not only to intentional jamming but may also be unintentionally jammed by other communications signals. While some systems can overcome in-band interference with more signal power, covert systems may be limited to small amounts of transmitted power. The objective of this thesis is to investigate a method for resolving a frequency-hopped signal embedded in interference waveforms.

With exponential averaging in the frequency domain, the spectra of the interfering signals can be estimated as long as they are present over a period longer than that of the frequency-hopped signal. Certain FFT sizes and weights are more beneficial to achieving this estimate than others. The interference estimate can be used to extract the desired frequency-hopped signal through spectral division of the received signal with the estimate. This technique is designated as noise-normalization. Simulations in MATLAB demonstrate the use of the technique and show how the desired signal can be resolved.

**KEYWORDS:** Noise-Normalization, Frequency-Hopped, Interference Estimate, Exponential Average

## UNDERSEA ACOUSTIC PROPAGATION CHANNEL ESTIMATION

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This research concerns the continuing development of Seaweb underwater networking. In this type of wireless network, the radio channel is replaced by an underwater acoustic channel, which is strongly dependent on the physical properties of the ocean medium and its boundaries, the link geometry and the ambient noise. Traditional acoustic communications have involved a priori matching of the signaling parameters (e.g., frequency band, source level, modulation type, coding pulse length) to the expected characteristics of the channel. To achieve more robust communications among the nodes of the acoustic network, as well as high quality of service, it is necessary to develop a type of adaptive modulation in the acoustic network. Part of this process involves estimating the channel scattering function in terms of impulse response, the Doppler effects, and the link margin. That is possible with the use of a known probe signal for analyzing the response of the channel. The estimated channel scattering function can indicate the optimum signaling parameters for the link (adaptive modulation). This approach is also effective for time varying channels, including links between mobile nodes (e.g., two submarines), since the channel characteristics can be updated each time a probe signal is sent.

**KEYWORDS:** Adaptive Modulation, Underwater Communications, Channel Estimation, Acoustic Propagation

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# ELECTRICAL ENGINEERING

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## PHOTONIC ANALOG-TO-DIGITAL CONVERSION USING A ROBUST SYMMETRICAL NUMBER SYSTEM

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Second Reader: John P. Powers, Department of Electrical and Computer Engineering

A photonic analog-to-digital converter (ADC) based on a robust symmetrical number system (RSNS) is constructed and tested. The analog signal to be converted is used to amplitude modulate an optical pulse from a laser using three Mach-Zehnder interferometers (MZI). The Mach-Zehnder interferometers fold the input analog signal for a three-channel RSNS encoding. The folding waveforms are then detected and amplitude-analyzed by three separate comparator banks, the outputs of which are used to determine a digital representation of the analog signal.

This design uses the RSNS preprocessing to encode the signal with the fewest number of comparators for any selected bit resolution. In addition to the efficiency of its use of comparators, the RSNS encoding has inherent Gray-code properties, making it particularly attractive for eliminating any possible encoding errors. The RSNS encoding is combined with an optical infrastructure that offers high bandwidth and low insertion loss characteristics.

A full implementation is constructed and tested. The lack of a high-speed data acquisition device limits the results to examining the preprocessing and digital processing separately. With the system integration of a data acquisition device, a wideband direct digital antenna architecture can be demonstrated.

**KEYWORDS:** Robust Symmetrical Number System, Photonic Analog-to-Digital Converter, Mode-Locked Laser

## SWARM INTELLIGENCE FOR AUTONOMOUS UNMANNED AERIAL VEHICLE (UAV) CONTROL

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Unmanned Aerial Vehicles (UAVs) are becoming vital warfare platforms because they significantly reduce the risk to human life while accomplishing important missions. A UAV can be used for example, as stand-in sensor for the detection of mobile, low-probability-of-intercept battlefield surveillance and fire control emitters. With many UAVs acting together as a swarm, the location and frequency characteristics of each emitter can be accurately determined to continuously provide complete battlefield awareness. The swarm should be able to act autonomously while searching for targets and relaying the information to all swarm members. In this thesis, two methods of autonomous control of a UAV swarm are investigated. The first method investigated is the Particle Swarm Optimization (PSO) algorithm. This technique uses a non-linear approach to minimize the error between the location of each particle and the target by accelerating particles through the search space until the target is found. When applied to a swarm of UAVs, the PSO algorithm did not produce the desired performance results. The second method uses a linear algorithm to determine the correct heading and maneuver the swarm toward the target at a constant velocity. This thesis shows that the second approach is more practical to a UAV swarm. New results are shown to demonstrate the application of the algorithm to the swarm movement.

**KEYWORDS:** Unmanned Aerial Vehicles, UAVs, Autonomous Behavior, Particle Swarm Optimization

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## **ATTITUDE DETERMINATION FOR THE THREE-AXIS SPACECRAFT SIMULATOR (TASS) BY APPLICATION OF PARTICLE FILTERING TECHNIQUES**

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**Master of Science in Systems Engineering-June 2005**

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The accurate determination of spacecraft attitude has always been a critical issue in many applications. The presence of imperfect sensors introduces errors in the system and affects the outcome of the mission. One of the most significant sensors is the rate gyroscope. In particular, the rate gyros are known to degrade with time, introducing random noise and bias. This calls for estimation algorithms that process the measured data in order to reduce the effects of the disturbances to a minimum. This research presents an approach that takes full advantage on the nonlinear dynamics and possibly non-Gaussian disturbances. It is based on recent work involving particle filters, where the probability density functions are approximated by a relatively large number of parameters. It is shown that accurate attitude estimation can be obtained with a manageable number of particles.

**KEYWORDS:** Particle Filter, Quaternion Representation, Attitude Determination, Rate Gyroscope, Nonlinear Estimation

## **OPTICAL DETECTION USING FOUR-LAYER SEMICONDUCTOR STRUCTURES**

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**Master of Science in Electrical Engineering-June 2005**

**Advisors: Gamani Karunasiri, Department of Physics**

**Douglas Fouts, Department of Electrical and Computer Engineering**

The application of a thyristor structure as an optical detector is explored. Based on laboratory experiments, which demonstrate that this device produces a pulse-mode output to incident light, the thyristor is investigated by comparing the existing theory of static forward-biased operation to simulation results obtained using ATLAS by Silvaco, Inc. The results include identification of the holding point on the IV curve by simulating the junction potential across each junction as a function of current, and demonstration that impact ionization is not a critical factor in thyristor operation. A series of simulations are performed which show that the thyristor can be optimized for use as a detector by decreasing the emitter efficiencies by decreasing the doping in the P1 and N2 layers, or by increasing the doping in the P2 layer; switching voltage can be controlled by selecting the doping and thickness of the N1 layer. A detector device is designed to allow further testing of the thyristor detector using the ABN CMOS process from AMI Semiconductor via the MOSIS service. The design of this device is discussed and simulated IV curves are presented.

**KEYWORDS:** Thyristor, Optical Detector, Pulse-Mode, Silvaco, ATLAS, Simulation

## **TRACKING HUMAN WALKING USING MARG SENSORS**

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**Master of Science in Systems Engineering-June 2005**

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This thesis addresses modeling and simulation of the human lower extremities in order to track walking motion and estimate walking distance. The lower extremities are modeled as an articulated object, which consists of rigid bars connected to each other by joints.

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This model is tested by using both synthetic and real data. The synthetic data is created based on the main principles of biomechanics. The real data is obtained from the MARG sensors and is processed by the Factored Quaternion algorithm. Next, it is implemented in a simulation program written in MATLAB. The program utilizes a mathematical model that represents the human gait-cycle and is based on the theory of forward kinematics, as well as on the theory of manipulator kinematics.

The simulation program is able to track the motion of the limbs that represent the lower extremities and estimate the traveled distance. Extensive laboratory tests verified the validity of the configuration.

**KEYWORDS:** MARG Sensors, Gait-Cycle, Forward Kinematics, Manipulator Kinematics, Human Walking Simulation, Position Estimation

## **MODELING AND SIMULATION OF THE PHYSICAL LAYER OF THE SINGLE CHANNEL GROUND AND AIRBORNE RADIO SYSTEM (SINGGARS)**

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In this thesis, the physical layer of the Single Channel Ground and Airborne Radio System (SINGGARS) is analyzed in order to gain insight into the bit error rate (BER) performance in various channel conditions. The bit error rate performance of the radio is examined using theoretical, simulation and experimental techniques. Results are presented in graphical form as the probability of bit error as a function of the energy per bit to noise power spectral density ratio. The results of the simulation show excellent agreement with the theory, while the experimental results deviate from theory at higher signal-to-noise levels. This suggests sub-optimal SINGGARS performance, most notably in the signal power to noise power range where reliable data transmission should take place.

**KEYWORDS:** Single Channel Ground and Airborne Radio System, SINGGARS, BFSK, Digital Communications, Faded Channels, Noncoherent Receivers, Modeling and Simulation

## **SIMULATION OF PERFORMANCE OF INFRARED PHOTODETECTORS**

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**Master of Science in Electrical Engineering-June 2005**

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**Robert Hutchins, Department of Electrical and Computer Engineering**

**John P. Powers, Department of Electrical and Computer Engineering**

In this thesis, the performance of a step quantum well infrared photodetector, designed by Kevin Lantz (June 2002) and experimentally studied by Michael Touse (September 2003) and Yeo Hwee Tiong (December 2004), is simulated in MATLAB using the transfer matrix method. The results, obtained by the MATLAB program, are compared with the experimental results in an attempt to make inferences about the optimum way of designing QWIP detectors. Simulation of the above implies a numerical solution of the Schrödinger equation, using algorithms and methods, which give accurate results. In this approach, the transfer matrix method (TMM) is used with exponentials and Airy functions to represent the solutions to Schrödinger equation under zero and non-zero bias, respectively. The calculated results are compared with the experimental data and found to provide a good agreement, which validates the accuracy of the model employed. In the final section of the thesis, authors examine and simulate in MATLAB the application of the extended Kalman filtering (EKF) to an infrared photodetector as a target tracking mechanism to both maneuvering and non-maneuvering targets. When one sensor is used for tracking, the results are reliable provided that the target does not maneuver. In the case of a maneuvering target, the results are significantly improved when both sensors are used for tracking.

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**KEYWORDS:** Asymmetric Quantum Well, Quantum Well Infrared Photodetector Under Electric Field, Absorption, Probability Current, Transfer Matrix Method, BOT, EKF

## CLOSED LOOP CONTROL OF A CASCADED MULTI-LEVEL CONVERTER TO MINIMIZE HARMONIC DISTORTION

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**Advisor: Robert Ashton, Department of Electrical and Computer Engineering**

**Second Reader: Alexander Julian, Department of Electrical and Computer Engineering**

As the United States Navy moves toward the all-electric ship, the need for a robust, high fidelity inverter for propulsion motors becomes mandatory. Military vessels require high power converters capable of producing nearly sinusoidal outputs to prevent torque pulsations and electrical noise that can compromise the mission location. This thesis presents a hybrid pulse width-modulated-controller for a 3x3 Cascaded Multi-Level Converter (CMLC). Ancillary results include a simple technique for extracting the reference sine wave from an independent bulk converter and implementing a synchronization technique that coordinates a space vector modulation controller with the switching pattern of a bulk inverter. The algorithms are tested on CMLC hardware that resides in the Naval Postgraduate School Power Systems Laboratory, and the results are compared with a sine-triangle pulse width modulation algorithm. The controller and converter are used to power a quarter-horsepower three-phase induction motor.

**KEYWORDS:** Cascaded Multi-Level Converter, Space Vector Modulation, Sine-Triangle Pulse Width Modulation, Neutral Point Clamped, Digital Phase-Locked Loop, Uncoupled Control, DD(X), dSPACE, Integrated Power System, All Electric Ship, Electric Propulsion

## A PERFORMANCE ANALYSIS OF MANAGEMENT INFORMATION DUE TO DATA TRAFFIC PROVISIONING IN A SONET/SDH COMMUNICATIONS NETWORK

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**Second Reader: Weilian Su, Department of Electrical and Computer Engineering**

An evaluation of the performance of a SONET management system is conducted to better understand its management capabilities due to network disruptions in the presence of a traffic load. This study analyzes the Cisco Transport Manager (CTM), which manages a testbed of four Cisco ONS15454 optical systems. The network is injected with HTTP and FTP traffic generated by the Spirent Smartbits system installed with TeraMetrics Gigabit Ethernet modules and load calibration configured by the Spirent Avalanche software. To simulate real-world situations, power disruptions are applied to the network while collecting CTM traffic using a packet analyzer. Using queuing analysis, the arrival rates and service times are computed for various CTM traffic components and a utilization for 2500 network elements (NE) is extrapolated. Self-similarity analysis is performed and the log-variance is plotted to extract the Hurst values. Finally, the results and findings are compared with prior research for loading and no-loading cases. Final analysis on the effects of link utilization on the queue size shows that the CTM is able to manage more NEs when the network is disrupted. Unfortunately, managing more NEs increases the queue size, even though the utilization is found to be 0.83 for 5450 NEs. Consequently, in order to maintain a moderate queue size, the maximum number of NEs manageable is found to be 2,495. This value is close to CISCO's specification of a CTM server managing a maximum of 2500 NEs.

**KEYWORDS:** SONET, Cisco, ONS15454, Cisco Transport Manager, Spirent, Smartbits, Avalanche, SNMP, Traffic Analysis, Self-Similarity, Long-Range Dependence, Heavy-Tailed, Interarrival Times, Packet Sizes, Queuing Theory, Link Utilization

# ELECTRICAL ENGINEERING

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## CONSTANT AND POWER OF TWO SEGMENTATION ALGORITHMS FOR A HIGH SPEED NUMERICAL FUNCTION GENERATOR

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Second Reader: Phillip E. Pace, Department of Electrical and Computer Engineering

The realization of high-speed numeric computation is a sought-after commodity for real world applications, including high-speed scientific computation, digital signal processing and embedded computers. An example of this is the generation of elementary functions, such as  $\sin(x)$ ,  $e^x$  and  $\log(x)$ . Sasao, Butler and Reidel developed a high-speed numeric function generator using a look-up table (LUT) cascade. Their method used a piecewise linear segmentation algorithm to generate the functions. In this thesis, two alternative segmentation algorithms are proposed and compared to the results of Sasao, Butler and Reidel [Ref.1]. The first algorithm is the Constant Approximation. This algorithm uses lines of slope zero to approximate a curve. The second algorithm is the power-of-2-approximation. This method uses  $2^i x$  to approximate a curve. The constant approximation eliminates the need for a multiplier and adder, while the power-of-2-approximations eliminates the need for multiplier, thus improving the computation speed. Tradeoffs between the three methods are examined. Specifically, the implementation of the piecewise linear algorithm requires the most amount of hardware and is slower than the other two. Its advantage is that it yields the least amount of segments to generate a function. The constant approximation requires the most amount of hardware to realize a function, but is the fastest implementation. The power-of-2 approximation is an intermediate choice that balances speed and hardware requirements.

**KEYWORDS:** Numerical Function Generator, Segmentation Algorithms, Piecewise Linear Approximation, Constant Approximation, Power of 2 Approximation



# MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

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## UNDERSEA NAVIGATION VIA A DISTRIBUTED ACOUSTIC COMMUNICATIONS NETWORK

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**Master of Science in Engineering Acoustics-June 2005**

**Advisor: Joseph A. Rice, Space and Naval Warfare Systems Center-San Diego**

**Second Reader: Clyde L. Scandrett, Department of Applied Mathematics**

Acoustic modems are the basis for emerging undersea wireless communications networks. U.S. Navy Seaweb technology offers an opportunity to perform undersea navigation and tracking by virtue of node-to-node ranging measurements acquired as a by-product of the acoustic communications protocol. A simple localization algorithm is developed and verified with synthetic data and is then tested with an Unmanned Undersea Vehicle (UUV) during an experiment at sea.

**KEYWORDS:** Undersea Navigation, Acoustic Communications Network, *ARIES*, UUV, Seaweb, Network Localization, Telesonar, Navigation, Tracking

## INVESTIGATIONS OF PARAMETRIC EXCITATION IN PHYSICAL SYSTEMS

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**Second Reader: Thomas Hoffer, DoD Contractor, Monterey Technical Design**

Parametric excitation can occur when the value of a parameter of an oscillator is modulated at twice the natural frequency of the oscillator. The response grows exponentially and is only limited by a nonlinearity of the system, so large response amplitudes typically occur. However, there is no response unless the parametric drive amplitude is above a threshold value that is dictated by the damping. Parametric excitation in three physical systems is investigated. The first involves an acoustic standing wave in a pipe that is driven by a piston at one end. An analysis shows that parametric excitation is not feasible in this system unless one uses a very large-excursion piston (for example, from an aircraft engine). The second system is an inductor-capacitor circuit, which can undergo oscillations of the current. An analysis of capacitance modulation with a bank of alternate rotating and stationary parallel plates shows that parametric excitation would be very difficult to achieve. Finally, the construction of a torsional oscillator whose length is modulated is described. Parametric excitation is successfully demonstrated in this system. A comparison of data to predictions of the standard theory of parametric excitation reveals significant deviations.

**KEYWORDS:** Parametric Excitation, Torsional Oscillator, Capacitance Modulation, Length Modulation



# MASTER OF SCIENCE IN INFORMATION SYSTEMS AND OPERATIONS

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## THE ROLE OF PUBLIC DIPLOMACY, PUBLIC AFFAIRS, AND PSYCHOLOGICAL OPERATIONS IN STRATEGIC INFORMATION OPERATIONS

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Master of Science in Information Systems and Operations-June 2005

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Steve Iatrou, Department of Information Sciences

Organizing for and conducting effective public affairs (PA), public diplomacy (PD) and psychological operations (PSYOPS) in support of national security objectives is a complex endeavor. In many instances, the desired psychological “effects” are contingent on the efficiency of the organizational structure conducting the programs themselves, along with the development and dissemination of appropriate messages and themes. At present, the U.S. Government’s (USG) ability to influence on a global scale is deficient due to fragmented organizational structure and underdeveloped doctrine relating to strategic influence. Duplication of efforts, inconsistent themes and the lack of a long-term, strategically focused, integrated information strategy have been inhibiting factors to American foreign policy success. This thesis examines public diplomacy, public affairs and psychological operations, and looks at how the U.S. Government has organized for and conducted strategic influence as it relates to Operation Iraqi Freedom.

**KEYWORDS:** Information Operations, Public Affairs, Public Diplomacy, Psychological Operations, Influence Operations, Strategic Communications, Strategic Influence, Information Programs



# MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

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## IMPLEMENTATION AND ANALYSIS OF THE CHROMAKEY AUGMENTED VIRTUAL ENVIRONMENT (CHRAVE) VERSION 3.0 AND VIRTUAL ENVIRONMENT HELICOPTER (VEHELO) VERSION 2.0 IN SIMULATED HELICOPTER TRAINING

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Advisors: CDR Joseph A. Sullivan, USN, MOVES Institute (Modeling, Virtual Environments, and Simulation)

Rudolph Darken, MOVES Institute (Modeling, Virtual Environments, and Simulation)

The Chromakey Augmented Virtual Environment (ChrAVE) 3.0 System is a training system created to augment initial, refresher and proficiency training in helicopter aviation using accurate simulation. Designed around advanced chromakey technologies, this system is deployable, scalable and flexible, allowing for use in austere environments such as aboard ship or in forward deployed locations. The goal of system development was to prove that a collection of commercially available components could be integrated along with the Virtual Environment Helicopter (VEHELO) 2.0 software package in order to provide a realistic simulated environment in which pilots can practice skill sets that are critical to mission success.

The focus of this thesis is the validation of ChrAVE 3.0 as an augmented trainer that can be adapted for use inside an actual aircraft cockpit. By placing the pilot in the most realistic simulation available, ChrAVE 3.0 will enhance development of skills such as Terrain Appreciation, Crew Resource Management (CRM), and Situational Awareness (SA). Continuing past research, this thesis analyzes empirical data collected from training flights to further prove its value as an instructional tool. ChrAVE 3.0 is housed in three man-portable containers and can be set up within minutes with little or no prior experience.

**KEYWORDS:** Chroma Key, Chromakey, Chromamatte, Fleet Replacement Squadron, FRS, Cre Resource Management, Situational Awareness, Helicopter, Human-Computer Interface, Mission Rehearsal, Navigation, Route Rehearsal, Spatial Orientation, Litering, Refresher Aircrew Training, ChrAVE, Terrain Association, Virtual Environments, Vehelo, LED Light Ring

## AN ANALYSIS OF THE DEPARTMENT OF DEFENSE (DOD) CERTIFICATION AND ACCREDITATION PROCESS

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Master of Science in Information Technology Management-June 2005

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Second Reader: James Ehler, Department of Information Sciences

The Department of Defense (DoD) current strategic vision is to ensure that information superiority is maintained across the full spectrum of operations. Hence, one of the greatest challenges facing this vision is to secure the information infrastructure. Protection of the infrastructure entails the standoff of a myriad of attacks and malicious activity such as denial-of-service, viruses and Trojan horses. A daunting challenge in itself, protection of the infrastructure succeeds only with a strong policy, process, and standard. The current process used to ensure protection is the DoD Information Technology Security Certification and Accreditation Process (DITSCAP). It is currently being revised to the DoD Information Assurance Certification and Accreditation Process (DIACAP).

This thesis analyzes current and past applications of the DITSCAP to evaluate successes and failures. Due to the large number of personnel who use the process and the astronomical cost associated with

# INFORMATION TECHNOLOGY MANAGEMENT

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traveling to each of their commands, the method selected to obtain data for analysis was a survey and phone interviews. The response rate of the study was 56%. Furthermore, it is worth noting that data was collected from key roles and their supporters who used the process to certify and accredit information systems. The survey was web-based and the link was emailed to personnel who use the process. In addition, the author of this thesis conducted interviews.

The objective of this thesis is to provide recommendations for improving the process that should be considered in developing the DIACAP.

**KEYWORDS:** DITSCAP, DIACAP

# **MASTER OF SCIENCE IN LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT**

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## **AN ANALYSIS OF HISPANIC MIDSHIPMEN SUCCESS AT THE UNITED STATES NAVAL ACADEMY**

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B.S., United States Naval Academy, 1997**

**Master of Science in Leadership and Human Resource Development-June 2005**

**Advisors: William R. Bowman, United States Naval Academy  
Susan P. Hocevar, Graduate School of Business and Public Policy**

This research studies the success of Hispanic midshipmen at the Naval Academy. Specifically, graduation, senior leadership positions during first class (senior) year, military performance grades, and cumulative academic Quality Point Rating (college GPA) are examined as the measures of success. A host of pre-entry variables are used to control any affect they might have that would otherwise be confounded with midshipmen's ethnic, racial, or gender identification. Midshipmen from the classes of 1999 to 2004 compose the dataset for regression analysis. Hispanic midshipmen cannot be studied in a vacuum, and therefore, this research generates information on a number of different groups. However, the performance of Hispanic midshipmen at the Naval Academy is of primary focus throughout. Of the four measures of success, this study shows that Hispanic midshipmen are likely to have a lower cumulative academic QPR, but are proportionately represented in terms of graduation, senior leadership positions, and military performance grades.

**KEYWORDS:** Naval Academy, Hispanic, Success

## **DOES THE UNITED STATES NAVAL ACADEMY ADMISSION BOARD EVALUATE AN APPLICANT'S MORAL VALUES? IF SO, HOW?**

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**Master of Science in Leadership and Human Resource Development-June 2005**

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If moral character is an important trait for an officer, one would assume that the United States Naval Academy would admit only those who possess the highest moral values and the potential for further development. This study explores that assumption. Through literature review, this study examines the Admission Board's charter, each step of the admissions process and the practice used for evaluating an applicant's moral values. The study considers the impact of the espoused values of the Naval Academy on the Admissions Board members and their determinations with regard to applicants.

**KEYWORDS:** Moral Identity, Values, Character, Admissions Board, Naval Academy

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## **LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT**

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### **ATTRITION AT THE UNITED STATES NAVAL ACADEMY: AN ANALYSIS OF ACADEMIC ASSISTANCE PROGRAMS ON AT-RISK STUDENTS**

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**Master of Science in Leadership and Human Resource Development-June 2005**

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**William R. Bowman, United States Naval Academy**

This research is designed to examine the impact of academic assistance programs at the United States Naval Academy on at-risk students. Each year, a percentage of students at the United States Naval Academy are enrolled in an academic assistance program known as the Plebe Intervention Program. This program is only offered to those students who are deemed at-risk and susceptible to academic difficulties. Another academic assistance program that is offered is known as the Midshipmen Group Study Program. This program, which is voluntary and offered to all students at the United States Naval Academy, is based on the supplemental instruction model that was developed at the University of Missouri-Kansas City.

This study analyzes the impact of each form of academic assistance in determining the likelihood of student progression beyond the freshman year. Students who represent the most at-risk students at the United States Naval Academy are compared against students with similar entrance characteristics. This study hypothesizes that student participation in each of the academic assistance programs correlates to persistence. In addition, this study hypothesizes that student participation in the Midshipmen Group Study Program leads to higher persistence rates among at-risk students than those who merely participate in the Plebe Intervention Program.

Results of the study indicate that participation in the Midshipmen Group Study Program leads to an increase in academic performance and higher persistence rates than those students who do not participate. In addition, students enrolled in the Plebe Intervention Program are no less likely to attrite during their freshman year than students with similar entrance characteristics who are not enrolled in the Plebe Intervention Program.

**KEYWORDS:** Academic Assistance Programs Supplemental Instruction At-Risk Students Attrition United States Naval Academy

### **TREATMENT OF FOURTH CLASS MIDSHIPMEN: HAZING AND ITS IMPACT ON ACADEMIC AND MILITARY PERFORMANCE; AND PSYCHOLOGICAL AND PHYSICAL HEALTH**

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In 1992, the General Accounting Office conducted a study at the U.S. service academies to determine the prevalence of hazing and its impact on psychological and physical health and academic and military performance. Based on the literature, it is theorized that the prevalence of hazing has changed. Furthermore, it is hypothesized that hazing will negatively impact both academic and military performance and psychological and physical health. These hypotheses are tested using a series of cross tabulation analyses, Pearson-correlation coefficients, and multiple hierarchical regressions on population data, classes 2005 through 2008. Cross tabulation analyses measure the prevalence of 23 hazing behaviors for the sample population. Correlation coefficients measure the relationship between hazing and several performance and health outcomes. Finally, multiple hierarchical regression analyses assess the impact of hazing experiences on academic and military performance and psychological and physical health. The study concludes that hazing has declined in the past 12-years. Furthermore, hazing is correlated as hypothesized to all of the outcomes examined except for academic and military performance. Finally, regression analyses determine that hazing impacts psychological and physical health, but only partially impacts academic and military performance.

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## **LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT**

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**KEYWORDS:** Hazing, Psychological and Physical Impact, Academic and Military Performance Impact, Plebe Summer, Fourth Class Development System

### **GENDER REPRESENTATION TRENDS AND RELATIONS AT THE UNITED STATES NAVAL ACADEMY**

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**Master of Science in Leadership and Human Resource Development-June 2005**

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**Master of Science in Leadership and Human Resource Development-June 2005**

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This study employed quantitative and qualitative methods to examine gender trends and the quality of gender interactions at the United States Naval Academy (USNA). In addition to gender, midshipmen demographics, experiences, personality types, interests and graduation outcomes are compared within and across gender for graduation years 1980, 1985, 1990, 1995, 2000 and 2004. Representation of women has increased to the current high of around 16%. Further, the data reveal similarities and differences between men and women in terms of their non-gender characteristics. Women's SAT scores and Cumulative Quality Point Ratios (QPRs) are on par with the men's. Proportionally, women are more likely to be extroverts and varsity athletes than are men. Women are less likely to be technical majors. Women are being afforded leadership experiences to the same extent as men. Perceptions regarding gender relations and cohesion are assessed through focus groups conducted with 110 midshipmen. Although gender representation has increased, and the Administration is credited with improving the explicit climate, there does not yet exist a completely gender-neutral or women "friendly" climate. The preponderance of findings regarding gender interactions at the Naval Academy suggests that male midshipmen have yet to fully accept female midshipmen. The Naval Academy must continue to confront the subsurface issues and dynamics persisting amongst male and female midshipmen. Recommendations include making an institutional commitment to improving gender interactions and company cohesion, securing alumni cooperation and involving midshipmen in improving the gender climate.

**KEYWORDS:** Gender Representation, Interactions, Relations

### **THE PROPENSITY FOR MENTORSHIP AT THE UNITED STATES NAVAL ACADEMY: A STUDY OF NAVY AND MARINE CORPS JUNIOR OFFICERS**

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**Master of Science in Leadership and Human Resource Development-June 2005**

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**W. Brad Johnson, United States Naval Academy**

This study examines junior officers at the United States Naval Academy, and their commitment to mentor midshipmen. Survey data are reported from 148 Navy Lieutenants and Lieutenant Commanders and Marine Corps Captains and Majors stationed on the Naval Academy yard. The purpose of this study is to better understand the mentoring experiences, dispositions and motivations among junior officers at the Naval Academy and to identify how previous mentorship experience, pro-social behaviors and personal (versus instrumental) motives relate to junior officer willingness to mentor Naval Academy midshipmen. The study concludes that helping others and benefiting the organization appear to be the distinguishing sources of motivation for junior officers who choose to mentor. Additionally, it finds that a junior officer's willingness to mentor and their levels of other-oriented empathy are associated with whether or not they chose to mentor. Lastly, this study reports that junior officers who were familiar with mentorship, and had previously been mentored in the fleet chose to mentor midshipmen at a much higher rate than their peers who were never protégés to a mentor.

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## LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

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**KEYWORDS:** Mentoring, Junior Officer Mentors, Mentoring and Midshipmen, Mentoring at the U.S. Naval Academy, Previous Mentorship Experience, Military Mentorship

### STUDY OF GENDER DIFFERENCES IN PERFORMANCE AT THE U.S. NAVAL ACADEMY AND U.S. COAST GUARD ACADEMY

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This thesis compares the academic and military performance of women with that of men at the U.S. Naval Academy (USNA) and U.S. Coast Guard Academy (USCGA). Measures of performance are grade-point average and military proficiency scores. The SAT scores for men and women at the two academies are also compared. The population includes the classes of 1997 through 2003, totaling 1,184 cadets from USCGA and 6,598 midshipmen from USNA. A number of hypotheses are tested quantitatively for all cadets and midshipmen from these classes, as well as for those who majored in a technical discipline. The results indicate that women at the two academies generally perform as well or better than do their male counterparts. This was especially true on measures of military proficiency, where women tended to outperform men, particularly those who were enrolled in a technical major. Further research should seek to explain gender differences in performance, given the pressures on women at these institutions and differences in scores on the SAT. Continued study of gender differences is recommended, and examples of possible research are provided.

**KEYWORDS:** Women, Military Performance, Academic Performance, Naval Academy, Coast Guard Academy

### AN ANALYSIS OF LEADERSHIP OPPORTUNITIES, EXPERIENCES, AND INFLUENCES AT THE UNITED STATES NAVAL ACADEMY FROM THE PERSPECTIVE OF THE MIDSHIPMEN

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**Master of Science in Leadership and Human Resource Development-June 2005**

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**Master of Science in Leadership and Human Resource Development-June 2005**

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**Linda D. Mallory, United States Naval Academy**

This thesis explores the leadership opportunities available to midshipmen at the United States Naval Academy, from the perspective of the midshipmen. The purpose is to identify which leadership opportunities, experiences and influences are viewed as highly beneficial to their development as leaders. The research is primarily qualitative in nature, using focus groups with 12 cohorts of midshipmen. Additionally, a quantitative analysis is conducted to compare and contrast the results. The results of this study indicate that the midshipmen primarily learn leadership from other midshipmen, role models, formal leadership positions they fulfill (specifically small unit leadership positions), gender relations and the classroom environment. This thesis presents recommendations to highlight and expand additional leadership positions, experiences or opportunities for midshipmen leadership development. Recommendations for improvements in leadership instruction are also provided.

**KEYWORDS:** Leadership, Leadership Development, Peer Leadership, Negative Leadership, Transformational Leadership, Gender Relations, United States Naval Academy, USNA, Midshipman, Midshipmen

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## LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

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### PERCEIVED DIFFERENCES IN SELF-REPORTED PROBLEMS WITH SEXUAL HARASSMENT, RACIAL PREJUDICE, AND DRUG MISUSE AMONG U.S. NAVAL ACADEMY (USNA) VARSITY ATHLETES

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This thesis examines perceptions regarding sexual harassment, racial prejudice and drug misuse among U.S. Naval Academy (USNA) varsity athletes. Based on previous research, it is hypothesized that both gender and minority status would be predictive of perceptions regarding these behaviors among midshipmen and midshipmen athletes. The thesis also explores the relationship between indicators of athletic participation and experiences and perceptions regarding sexual harassment, racial prejudice and drug misuse. Data from 2,735 midshipmen who responded to the USNA Values Survey and 723 midshipmen-athletes who responded to the NAAA Exit Survey were used for analyses. Results of regression analyses indicate that both gender and ethnicity were significant predictors of sexual harassment and racial prejudice but not drug misuse. Athletic status did not significantly influence perceptions. Implications of these findings are discussed for understanding midshipmen perceptions of these behaviors.

**KEYWORDS:** United States Naval Academy, USNA, Naval Academy Athletic Association, NAAA, National Collegiate Athletic Association, NCAA, Athlete, Recruit, Blue-chip, Varsity, Sport, Sexual Harassment, Racial Prejudice, Drug Misuse, Midshipman

### THE IMPACT OF DEMOGRAPHICS AND MILITARY FACTORS AFFECTING RETENTION OF FEMALE AND MALE OFFICERS IN THE SURFACE WARFARE AND RESTRICTED LINE COMMUNITIES

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This study analyzes factors that affect retention of male and female officers with specific emphasis on the Surface Warfare and restricted line communities. The research examines whether family influence, dependent status, accession source and undergraduate major are differentially related to retention by gender and community. This study evaluates these officers from date of commissioning to the 10-year point in an effort to derive factors related to retention after reaching a major career milestone. A logistic regression model is used as the analytic strategy for the study. Descriptive statistics on independent and dependent variables are run, as appropriate, to show retention rates and outcomes from six cohorts (1988-1993) while controlling for missing data, missing cases, personnel who died prior to the 10-year point, Marine Corps Officers, aviators, staff corps and submariners. The findings of this study evaluate whether retention of female and male officers is related to the same predictors. The results provide data to policy makers and Navy personnel to better predict, control and maintain retention rates.

**KEYWORDS:** Retention, Community, Surface Warfare, Restricted Line, Gender

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# LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

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## **A QUANTITATIVE ANALYSIS OF THE IMPACT OF THE SUMMER TRAINING PROGRAM ON MIDSHIPMEN SERVICE SELECTING AT THE UNITED STATES NAVAL ACADEMY**

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This thesis examines the effect of the Summer Training Program on the vocational development of midshipmen at the United States Naval Academy. Data from 355 First Class midshipmen are analyzed to examine the impact of the Summer Training Program on United States Naval Academy Midshipmen career choices. It is hypothesized that the Summer Training Program would have a significant impact on career selection after controlling for the effects of demographic, academic and military factors. Results of hierarchical regression analyses indicate that the Summer Training Program has a differential impact on Midshipmen's career choice. Specifically, it is found that participating in career relevant training has a significant impact on both tentative career choice and final career choice. All of the Summer Training Programs are found to be significant in the study. The results suggest that the greatest impact for career choice is on those Midshipmen that participate in the Leatherneck Summer Training Program.

**KEYWORDS:** Summer Training Program, United States Naval Academy, Job Satisfaction, Warfare Community Selection

## **A MODEL MIDSHIPMAN: FACTORS RELATED TO ACADEMIC AND MILITARY SUCCESS OF PRIOR ENLISTED MIDSHIPMEN AT THE UNITED STATES NAVAL ACADEMY**

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**Advisors: Alice Crawford, Graduate School of Business and Public Policy  
Eric Fredland, United States Naval Academy**

This research analyzes performance at the U.S. Naval Academy (USNA) and attrition of Midshipmen who have prior-enlisted experience in the Navy and Marine Corps. The primary hypothesis of this study is that the experience gained by enlisted service members provides them with valuable tools and training that helps them overcome perceived academic deficiencies and enables them to be successful at the Naval Academy. Linear and bi-Linear regression models are used to analyze the influence of prior-enlisted experience on academic and military performance at the Naval Academy on the classes from 1999 through 2004. Results show that while prior-enlisted arrive at the Naval Academy with lower academic standings in high school and lower SAT scores when compared to direct-entry Midshipmen, they still perform at a higher level than direct-entry Midshipmen in the areas of academic and military rankings when compared to direct-entry Midshipmen with similar academic backgrounds. The study also finds that while prior-enlisted and direct-entry Midshipmen attrite at nearly the same rate from the Naval Academy, the reasons for attrition are quite different, showing that their background in the military has changed their perspectives in some way.

**KEYWORDS:** Systems

# **MASTER OF SCIENCE IN MANAGEMENT**

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## **COMPARISON OF THE PRICE AND VOLATILITY OF CURRENT AND ALTERNATIVE MODELS FOR THE ACQUISITION OF DIRECT SUPPLY NATURAL GAS FOR THE DEPARTMENT OF DEFENSE**

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**Master of Science in Management-June 2005**

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The Department of Defense (DoD) is the largest user of energy in the nation. DoD utilizes the Defense Energy Support Center (DESC) to procure a large portion of its natural gas. In this study, the author determines whether the current buying approach utilized by DESC or an alternative approach present a better method to reduce the pricing risks associated with market timing and volatility. In order to determine how market timing and volatility affect purchasing, historical data for actual monthly prices of the current program and data from market pricing indices for a statistical model are analyzed. The data for the current model and the statistical model are compared using averages prices and standard deviation to determine which model provided better overall results. The analysis proves that entering the market to purchase natural gas more frequently and using firm fixed price contracts results in an overall lower average price with less variability than using the current method of purchasing. This study recommends that DESC consider a pilot program, beginning in the Northeast region, where the current purchasing model produces the most volatility in pricing, to develop a procurement program which will support stabilized pricing for its DoD customers.

**KEYWORDS:** Natural Gas Pricing, Defense Energy Support Center, Utility Pricing



# MASTER OF SCIENCE IN MECHANICAL ENGINEERING

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## **FOLLOW THE LEADER: FORMATION CONTROL OF MULTIPLE AUTONOMOUS UNDERWATER VEHICLES USING FORWARD LOOKING SONAR**

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**Master of Science in Mechanical Engineering-June 2005**

**Advisor: Anthony J. Healey, Department of Mechanical and Astronautical Engineering**

With the Global War on Terrorism (GWOT) taking place in full force, autonomous vehicles have become a major asset to government forces. Expansion of single vehicle technology to multiple vehicle technology is required in order for the United States to stay ahead of its adversaries in the GWOT and other technological fields (such as oceanography). Multiple vehicle technology has been explored by many different institutions in the recent past (Leonard, 2001 and Kucik, 2003). Expansion of this technology will lead to greater autonomy and robustness amongst the vehicles. This thesis presents a simulation of a “follow the leader” behavior for multiple Autonomous Underwater Vehicles (AUVs). The follower vehicle incorporates the use of forward-looking sonar to track the leader vehicle. This process will free up bandwidth between acoustic modems, allowing data transfer to occur with greater efficiency. Hydrodynamic coefficients are used to develop steering equations that model *REMUS* through a track of specified waypoints similar to a real-world mission track. A two-dimensional forward looking sonar model with a 120° horizontal scan and a 110 meter radial range is modeled to track the leader vehicle. Resulting bearing and range between the two vehicles is incorporated as control for positioning the follower vehicle.

**KEYWORDS:** Formation, Underwater Vehicle, AUV, *REMUS*, Follow the Leader

## **VERTICAL PLACE OBSTACLE AVOIDANCE AND CONTROL OF THE *REMUS* AUTONOMOUS UNDERWATER VEHICLE USING FORWARD LOOK SONAR**

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**B.S., United States Naval Academy, 2004**

**Master of Science in Mechanical Engineering-June 2005**

**Advisor: Anthony J. Healey, Department of Mechanical and Astronautical Engineering**

**Second Reader: Douglas Horner, Department of Mechanical and Astronautical Engineering**

This thesis explores one of the major problems facing both commercial and military UUVs to date. Successfully navigating in unfamiliar environments and maneuvering autonomously to avoid obstacles is a problem that has yet to be fully solved. Using a simulated 2-D ocean environment, the work of this thesis provides results of numerous *REMUS* simulations that model the vehicle’s flight path over selected sea bottoms. Relying on a combination of sliding mode control and feedforward preview control, *REMUS* is able to locate obstacles such as seawalls using processed forward look sonar images. Once recognized, *REMUS* maneuvers to avoid the obstacle according to a Gaussian potential function. In summary, the integration of feedforward preview control and sliding mode control results in an obstacle avoidance controller that is not only robust, but also autonomous.

**KEYWORDS:** *REMUS*, Autonomous, Obstacle Avoidance, Sliding Mode Control, Autopilot, Image Processing, Vertical Place Equations of Motion

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# MECHANICAL ENGINEERING

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## FRICITION STIR PROCESSING OF NICKEL ALUMINUM PROPELLER BRONZE IN COMPARISON TO FUSION WELDS

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Master of Science in Mechanical Engineering-June 2005

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Friction Stir Processing (FSP) is currently being considered for use in manufacture of the Navy's NiAl bronze propellers. Incorporating this technology may improve service performance and enable reduction of manufacturing time and cost. This program of research employs miniature tensile sample designs to examine the distributions of longitudinal properties through the various regimes in a fusion weld. Also, the distributions of both longitudinal and transverse properties throughout the stir zones for selected FSP conditions are examined. Yield strengths are larger in various FSP conditions by at least a factor of two relative to fusion welds. Ultimate strengths are comparable in the weld pool and stir nugget. Widmanstätten microstructures and microvoid formation and coalescence in the fracture surface result in high ductilities in weld metal and the stir nugget. The thermomechanically affected zone of FSP and the heat affected zone of a fusion weld both exhibit low ductility. This may reflect formation of  $\beta$  upon heating to temperatures of 800-850°C, followed by rapid cooling and transformation of the  $\beta$  to form martensitic transformation products in their respective microstructures. For a single-pass raster pattern, transverse ductility is lower than longitudinal ductility. For a multi-pass raster, transverse ductility is higher than longitudinal ductility. For multi-pass raster and spiral patterns in FSP, the data show that the mechanical properties are more nearly isotropic.

**KEYWORDS:** Friction Stir Processing, Ni Al Bronze, Microstructure, Mechanical Properties

## IMPACT OF LEADING-EDGE ORIENTATION AND SHAPE ON PERFORMANCE OF COMPRESSOR BLADES

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Master of Science in Mechanical Engineering-June 2005

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Second Reader: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

This thesis presents a Computation Fluid Dynamics (CFD) analysis of the aerodynamic performance of circular and elliptical leading edges of compressor blades, with a range of leading-edge droop angles. Specifically, simulations are conducted with a free stream Mach number of 0.65 to quantify the change in pressure distributions and boundary layer momentum thickness in the leading edge region for a range of incidences on a flat plate with various leading-edge ellipticity ratios, ranging from unity (circular) to 5.5. In addition, the impact of drooping the leading edge is analyzed over a range of incidence angles from zero to 13 degrees. Pressure distributions indicate that elliptical leading edges can eliminate separation bubbles at zero incidence. The results indicate that the minimum loss occurs at an ellipticity ratio of about three, and elliptical leading edges with a droop slightly greater than the average incidence can significantly decrease aerodynamic losses over a wider range of incidences.

**KEYWORDS:** Leading Edge Direction, Leading Edge Shape, Separation Bubble, Computational Fluid Dynamics, Drooped Leading Edge, Ellipticity Ratio

# MECHANICAL ENGINEERING

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## CONTOUR TRACKING CONTROL FOR THE *REMUS* AUTONOMOUS UNDERWATER VEHICLE

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In the interest of enhancing the capabilities of autonomous underwater vehicles for use in U.S. naval operations, the ability to control vehicle position by following depth contours presents exciting potential for its application to navigation. The use of a contour tracking control algorithm in lieu of preprogrammed waypoint navigation not only has distinct advantages over the current status quo, but also offers insight into the possibility of navigational controls tied to other indirect sensors. This thesis presents two contour tracking control algorithms and examines the performance of each by simulating the response of the *REMUS* underwater vehicle to ideal and real-world bathymetry models.

**KEYWORDS:** Contour Tracking, Autonomous Control, Sensor Based Control, *REMUS*, Underwater Vehicle, AUV



# MASTER OF SCIENCE IN METEOROLOGY

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## FORECASTING HURRICANE TRACKS USING A COMPLEX ADAPTIVE SYSTEM

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Master of Science in Meteorology-June 2005

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Second Reader: John Hiles, MOVES Institute (Modeling, Virtual Environments, and Simulation)

Forecast hurricane tracks using a multi-model ensemble that is comprised by linearly combining the individual model forecasts have greatly reduced the average forecast errors when compared to individual dynamic model forecast errors. In this experiment, a complex adaptive system, the Tropical Agent Forecaster (TAF), is created to fashion a “smart” ensemble forecast. The TAF uses autonomous agents to assess the historical performance of individual models and model combinations, called predictors, and weights them based on their average error compared to the best track information. Agents continually monitor themselves and determine which predictors, for the life of the storm, perform the best in terms of the distance between forecast and best-track positions. A TAF forecast is developed using a linear combination of the highest weighted predictors. When applied to the 2004 Atlantic hurricane season, the TAF system, with a requirement to contain a minimum of three predictors, consistently outperforms, although not statistically significant, the CONU forecast at 72 and 96 hours for a homogeneous data set. At 120 hours, the TAF system significantly decreases the average forecast errors when compared to the CONU.

**KEYWORDS:** Tropical Cyclones, Hurricanes, Complex Adaptive System, Multi-Model Ensemble



# MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

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## UNDERSEA WARFARE (USW) AREA ANALOGS

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**Master of Science in Meteorology and Physical Oceanography-June 2005**

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Mary Batteen, Department of Oceanography**

The purpose of this project is to investigate the feasibility of and methodology for the development of a set of environmental analogs of operational Undersea Warfare (USW) areas within fleet training areas. It is primarily a discussion of the identification of parameters that characterize the tactical USW environment, prioritization of these parameters, identification of existing databases that contain these parameters and an outline of the processes required to extract the desired data from the databases. An example of two operational areas with probable analogous training areas is discussed in terms of the methodology proposed. Among the environmental parameters considered are bathymetry, sediment type, sound velocity profiles, acoustic response of the environment across a broad frequency spectrum (for both active and passive sonar), ambient noise, shipping density, bioluminescent properties, evaporation duct height, atmospheric surface duct height and gravitational anomalies. The project focus is primarily on acoustic oceanographic features but non-acoustic and atmospheric features are considered. There is an expectation that this project is the starting point for further research, software product development, data extraction, analog identification and promulgation of a tailored product to the fleet. The ultimate goal is to train for USW across the fleet in areas as much like the areas the Navy fights in as possible.

**KEYWORDS:** USW Analogs, Undersea Warfare Analogs, Acoustic Analogs, Analogous Operating Areas, Sound Velocity Profile, Acoustic Propagation, Undersea Warfare, Anti-Submarine Warfare, Fuzzy Logic Applications

## CUSPATE SHORELINE MORPHOLOGY

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Large beach cusps with wavelengths  $O(200m)$ , sometimes termed mega-cusps, were measured along 18km of the Southern Monterey Bay coastline from October 2004 to April 2005 to investigate the cusplate shoreline response to rip current systems. Monterey Bay is a unique location for the study of rip current systems, with well-defined rips that are present all year long, a large dune erosional rate and incident wave energy that is primarily shore-normal with a large along-shore gradient. Contours of the coastline are extrapolated from the surveys using an all-terrain vehicle equipped with Kinematic GPS. Cusp spacing is inferred from the data using a zero up-cross technique and found to be  $O(230m)$  for low wave energy beaches and  $O(250m)$  for high wave energy beaches. Migration rates of the cusps are found to be 1-5m/day owing to the quasi-uniform erosion of the dune system. Cusps are found to be semi-permanent features with length scales dependent upon the local wave climate.

**KEYWORDS:** Oceanography, Nearshore, Cusplate Shoreline, Rip Current, Dune Morphology

## PREDICTABILITY ASSOCIATED WITH THE DOWNSTREAM IMPACT OF THE EXTRATROPICAL TRANSITION OF TROPICAL CYCLONES

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Second Reader: Russell L. Elsberry, Department of Meteorology

Since an extratropical transition (ET) of a decaying tropical cyclone (TC) often results in a fast-moving, rapidly-developing extratropical cyclone and amplification of synoptic-scale systems far downstream, proper forecasting of ET events is critical to forecast accuracy over large ocean regions. Past studies have linked forecast accuracy to the phasing of a decaying TC with favorable midlatitude conditions. Because ET events are sensitive to the analyzed initial conditions, this phasing is examined using 11 member ensemble predictions available four times daily from the National Centers for Environmental Prediction, which are combined into a single 44-member ensemble based on a common forecast verification time. Recurring ET patterns within the 44-member ensemble are objectively identified using a combination of EOF and cluster analysis. Ensemble spread first appears near the point where the TC moves into the midlatitudes and then propagates downstream. Although ensemble spread in the forecast fields is large at extended forecast intervals, the ensemble spread, and the number of ET patterns identified in successive EPS predictions, decrease as the ET process becomes better defined. Within 48 hours of the ET event, the ensemble prediction system properly identifies the ET pattern with a minimum ensemble spread. Similar to Klein, et al. (2002), the shifts in the initial position of the TC and the subsequent dynamical coupling can explain differences between weak and strong ET re-intensifications.

**KEYWORDS:** Extratropical Transition, ET, Tropical Cyclones, Re-Intensification, Ensemble, EOF, Empirical Orthogonal Functions, Patterns, Mid-Latitude Phasing

# MASTER OF SCIENCE IN OPERATIONS RESEARCH

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## IMPROVING THE QUALITY AND PERSONNEL FILL RATES OF U.S. ARMY RESERVE UNITS

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Master of Science in Operations Research-June 2005  
Advisor: Samuel E. Buttrey, Department of Operations Research  
Second Reader: W. Matthew Carlyle, Department of Operations Research**

The most critical component of sustaining combat-ready United States Army Reserve (USAR) units is manning. Traditionally, the USAR has focused on maintaining the Congressionally mandated End Strength Objective (ESO), a total force requirement, at the expense of manning individual units. Historically, the USAR has met the overall ESO, but some individual units have become unbalanced. Many have been successful at manning soldiers above their authorized strength while others have struggled. Massive mobilizations in support of the Global War on Terrorism (GWOT) have highlighted the importance of manning units to their proper “fill rates.” The USAR has cross-leveled troops from overstrength to understrength units resulting in many problems. This thesis formulates and solves a model addressing the problem of maintaining appropriate AR unit manning. A prior thesis created a database of 30,000 zip codes, 800 Reserve Centers (RCs), and 264 Military Occupational Specialties (MOSs) that included demographic, vocational, and economic data and past military recruit production. A second thesis established requirements and constraints on recruiting. Together with these two theses, this work forms the Unit Positioning and Quality Assessment Model (UPQUAM), an optimization model that considers unit manning and the Military Available Population (MAP). Results indicate where the MAP best supports Army Reserve units. Each unit is associated with an existing Reserve Center (RC) and those that are not supported within a Regional Support Command’s (RSC) MAP are highlighted for later consideration in another RSC.

**KEYWORDS:** Army Reserve, Unit Stationing, Recruiting, Marketing, Reserve Center, United States Army Recruiting Command, USAREC

## AN ANALYSIS OF THE KILL CHAIN FOR TIME-CRITICAL STRIKE

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Master of Science in Operations Research-June 2005  
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Donald P. Gaver, Department of Operations Research  
Second Reader: Albert J. DeSanti, Naval Air Systems Command-Weapons Division**

Because of their limited window of vulnerability, the detection and destruction of Time-Critical Targets (TCTs) has been a significant challenge for U.S. military forces. The Naval Air Systems Command (NAVAIR) has investigated a future time-critical strike (TCS) architecture and concept of operations (CONOPS) in order to explore the effectiveness of high-speed weapons against TCTs. NAVAIR has implemented a network-centric architecture and CONOPS in a simulation model. This thesis extends NAVAIR’s work by developing flexible models and exploring the effects that alternative CONOPS and technology enhancements may have on high-speed weapon requirements and overall system performance against TCTs. The TCTs are a single wave of theater ballistic missile (TBM) transporter-erector-launchers (TELS) appearing over a short time interval. The wave of TBM TELS can saturate the command and

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control architectures considered. The CONOPS is to use weapons with the shortest fly-out times first. For the architecture and alternative CONOPS explored, it is difficult to improve upon the performance of the baseline TCS system developed by NAVAIR.

**KEYWORDS:** Time-Sensitive Strike, Time-Critical Strike, Simulation, Queuing, High-Speed Weapons, Kill Chain

### **STRATEGIC INVENTORY POSITIONING OF NAVY DEPOT LEVEL REPAIRABLES**

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Navy Inventory Control Point (NAVICP) is the principle controller of the Navy's inventory consisting of over 470,000 line items valued at over \$30B. NAVICP provides the Fleet the parts necessary to maintain weapons systems. In 2003, NAVICP spent over \$444M in transportation charges to fulfill customer requests for repair parts. The research in this thesis is the result of an initiative by NAVICP to study the benefits of modifying their current inventory positioning policy for repairable items. NAVICP wishes to incorporate a strategic inventory positioning policy that reduces transportation costs. This thesis develops the Strategic Inventory Positioning (SIP) model that looks at historical inventory demand and determines the optimal storage locations for NAVICP's inventory of repairable items. SIP provides NAVICP an optimization-based tool to aid in determining the strategic inventory location for each repairable item. Using results from SIP and historical transaction data, a cost comparative analysis of 176 of the highest cost and demand volume items shows that using a new synchronized and scheduled truck delivery system combined with strategically locating both new procurements and returns from repair in depots near high demand concentrations enables NAVICP to reduce annual transportation costs by an average of \$110K per repairable item.

**KEYWORDS:** Inventory Positioning, Logistics, Optimization, Linear Programming

### **OPTIMIZING FORMATION MOVEMENT OVER HETEREGENEOUS TERRAIN**

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**Master of Science in Operations Research-June 2005**

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**Second Reader: Ellen F. Roland, Rolands and Associates Corporation**

Formation movement is vital to preserve security among its units during military operations. Movement of a military formation is planned over real or simulated terrain, maximally preserving the relative positions of units in formation while it avoids barriers, and while its units avoid obstacles. Terrain is divided into homogeneous cells (say, squares), and a pair of neighboring cells is adjacent if the formation can transit between these cells while avoiding barriers with sufficient clearance. Authors induce a graph from these adjacencies, and determine the movement cost on each arc with a fine time-step simulation that finds local movement vectors to preserve relative formation position while avoiding approach too close to barriers or obstacles (this emulates solving differential equations with Euler's method). Authors then nominate an origin and a destination, select a shortest path and repeat the time-step simulation over this path to determine the individual positions of each unit as the formation makes its transit. Game designers and robot controllers have published schemes to guide formation movement, but their movements can penetrate barriers, and myopically, get caught in cul-de-sacs. By contrast, the authors guarantee that if a path exists that avoids these pitfalls, they will find it.

**KEYWORDS:** Formation Movement, Shortest Path, Dijkstra, Tactical Movement, Maintain Formation

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## **BASELINE ASSESSMENT OF THE DEPARTMENT OF THE ARMY COST ESTIMATING AND ANALYSIS (CE/A) AND COST MANAGEMENT (CM) CAPABILITIES**

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**Master of Science in Operations Research-June 2005**

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**Second Reader: Samuel E. Buttrey, Department of Operations Research**

This thesis assesses the current state of Department of Army (DA) cost estimating and analysis (CE/A) and cost management (CM) capabilities. In particular, it supports the mission of the Deputy Assistant Secretary of the Army (Cost and Economics) to provide the DA with cost, performance and economic analysis in the form of expertise, models, data, estimates and analysis at all levels; and it identifies opportunities for improvement in the way CE/A and CM communities can better serve the DA.

The first step in this thesis is to identify which organizations in the DA employed CE/A and CM personnel. Next, questionnaires with which to elicit the information required for a complete baseline assessment are constructed, tested and disseminated. Cost community employees complete the questionnaires. The data collected is formed into useful categories, and displayed in informative ways. With data thus arranged, analysis is performed and recommendations are made.

This thesis provides understanding of practices, techniques, and standards within the DA CE/A and CM communities. It is the first phase of a larger effort to understanding the changes in human capital strategy necessitated by the advent of the General Fund Enterprise Business System (GFEBS), the Army's version of enterprise-wide financial management systems.

**KEYWORDS:** Cost Management, Cost Estimating and Analysis, GFEBS

## **MODELING SOUND AS A NON-LETHAL WEAPON IN THE COMBAT<sup>XXI</sup> SIMULATION MODEL**

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**Master of Science in Operations Research-June 2005**

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**Second Reader: MAJ John Willis, USA, TRADOC Analysis Center**

Modeling and representing combat and individual soldiers is a complex task. Several factors influence combatant behavior. Using non-lethal methods has become one way for combatant commanders to accomplish their wartime mission. Current the Army and Marine Corps models are not capable of non-lethal weapon replication. The U.S. Army Training and Doctrine Command Analysis Center (TRAC), Monterey, California, has funded a program of research related to individual combatant representation in modeling and simulation. Modeling non-lethal weapons was identified by TRAC-Monterey as important to better represent actual combat. This thesis used COMBAT<sup>XXI</sup>, a high-resolution, closed-form, stochastic, analytical combat simulation, to replicate non-lethals and study the effects on individual combatants. Existing source code was modified to model the Long Range Acoustic Device (LRAD), the non-lethal platform chosen for this research. LRAD is an acoustic device designed to modify the behavior of personnel with a high intensity warning tone. Once the LRAD capability was developed, a scenario was developed to test the simulated effects of the device. A model was developed to accurately determine behaviors of individual combatants. It was concluded that the implementation of this new non-lethal capability in COMBAT<sup>XXI</sup> improved the model and created a more realistic representation of actual combat.

**KEYWORDS:** Combat Modeling, Behavior Rules, Long Range Acoustic Device, Modeling and Simulation, Non-lethal Weapons, Algorithm

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### **A KERNEL APPROACH TO THE ESTIMATION OF PERFORMANCE MEASURES IN A HELICOPTER AMBULANCE SERVICE WITH MISSING DATA**

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**Master of Science in Operations Research-June 2005**

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**Second Reader: Kyle Lin, Department of Operations Research**

Two different operational scenarios are studied for a regional air ambulance service-company which has bases in Northern California. Two of these bases serve the land areas encompassed roughly in a circular area of 100 miles radius, centered in Gilroy and Salinas, respectively. A large part of their coverage areas are reachable from either base. The base in Salinas currently operates one helicopter only from Thursday to Monday, whereas the base in Gilroy operates one helicopter 24/7. The company is considering extending the operation of one helicopter to 24/7 for its Salinas base. In this study, the operational impacts of that extension are analyzed, and a framework is developed that can be applied towards the study of the ambulance assignment problem faced by small operators.

**KEYWORDS:** Helicopter Ambulance, Kernel Density Estimator, Non-Homogeneous Poisson Process, Simulation

### **THE EFFECTS OF POSTURE, BODY ARMOR, AND OTHER EQUIPMENT ON RIFLEMAN LETHALITY**

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**Master of Science in Operations Research-June 2005**

**Advisor: Tom W. Lucas, Department of Operations Research**

**Second Reader:MAJ Richard Spainhour, USA, TRADOC Analysis Center**

How do body armor and posture affect soldier marksmanship? The Interceptor Body Armor (IBA) has significantly improved soldier combat survivability, but in what ways does it change rifleman lethality? Moreover, can these effects be modeled so as to develop better tactics and operational plans? This study quantifies the effects of soldier equipment on lethality through multi-factor logistic regression using data from range experiments with the 1<sup>st</sup> Brigade, 1<sup>st</sup> Infantry Division (Mechanized), at Fort Riley, Kansas.

The designed experiment of this study estimates the probability of a qualified U.S. rifleman hitting a human target. It uses the rifleman's equipment, posture, Military Occupational Specialty (MOS) and experience, along with the target's distance, time exposure and silhouette presentation, as input factors. The resulting family of mathematical models provides a Probability of Hit prediction tailored to a shooter-target scenario.

The study shows that for targets closer than 150 meters, soldiers shot better while wearing body armor than they did without body armor. Body armor has a negative effect for targets farther than 200 meters, and this could significantly impact the employment of the Squad Designated Marksman. The study also shows that the kneeling posture is an effective technique and recommends standardized training on this method of firing.

**KEYWORDS:** Hosmer-Lemeshow Test, IBA, Interceptor Body Armor, Lethality, Logistic Regression, Modeling, Posture, Probability of Hit, Rifleman, Simulation, Survivability, Simulation

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# OPERATIONS RESEARCH

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## DECISION CRITERIA FOR THE USE OF CANNON-FIRED PRECISION MUNITIONS

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B.S., Rochester Institute of Technology, 1994

Master of Science in Operations-June 2005

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Second Reader: LTC Jon Christensen, USA, Department of Operations Research

The U.S. Army and Marine Corps are developing guided munitions for cannon artillery. These munitions provide a significant increase in range and accuracy, but the tactics, techniques and procedures used to employ them have yet to be developed. This study is intended to assist with that development by providing a method to determine when to use these munitions rather than conventional munitions in order to achieve a tactical-level commander's desired objectives.

A combination of multi-attribute utility theory and simulation are used to determine the best ammunition (precision or conventional) to fire under certain battlefield conditions. The simulation, developed by the U.S. Army Research Laboratory, provides results on the full range of artillery effects by varying the different battlefield conditions that have the greatest effect on the accuracy of artillery. The results of simulated artillery fire missions are studied to determine the combination of battlefield conditions that produce the best results for each type of ammunition.

A decision model is used to account for a commander's expected preferences based on tactical considerations. The results vary greatly depending on the battlefield conditions and the commander's preferences. One type of projectile does not clearly dominate the other.

**KEYWORDS:** Field Artillery, Precision-Guided Munitions, Munitions Effects, Cannon, Fire Support, Firing Theory, Gunnery

## SIMULATION TO DETERMINE THE IMPACT OF LIFE-CYCLE MANNING ON LIEUTENANTS

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Master of Science in Operations Research-June 2005

Advisor: Paul J. Sanchez, Department of Operations Research

Second Reader: Samuel E. Buttrey, Department of Operations Research

The U.S. Army has proposed a new manning strategy to reduce personnel turbulence and build strong cohesive combat units. Life-cycle manning would synchronize officer assignment with the three-year life cycle of a Unit of Action (UA). This thesis uses simulation to examine the length of time an officer waits between graduation from the Basic Officer Leadership Course (BOLC) and assignment to a UA. The model is a discrete-event simulation based on a Java library called Simkit. This is a terminating simulation that provides the average delay lieutenants experience before unit assignment, over a 10-year period. This thesis uses robust design to evaluate both the mean performance and the variability of the system. By minimizing a quadratic loss function, optimal settings are determined that trade off some expected delay in order to achieve greater consistency. This analysis reveals that this system behaves like a queueing model in which officer accessions influence the arrival rate and the number of life-cycle units and their fill rates influence the service rates. Reducing officer accessions and the length of the life cycles while increasing the unit strength will keep the system stable and the expected delays smaller with greater consistency.

**KEYWORDS:** Life-Cycle Manning, Manpower, Simulation, Simkit, Regression, Robust Design

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# OPERATIONS RESEARCH

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## **AUDITORY DETECTION AND SOUND LOCALIZATION FOR COMPUTER-GENERATED INDIVIDUAL COMBATANTS**

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**B.S., United States Military Academy, 1995**

**Master of Science in Operations Research-June 2005**

**Advisor: Jeff Crowson, Department of Operations Research**

**Second Reader: MAJ Donovan Phillips, USA, TRADOC Analysis Center (TRAC)**

Soldiers rely predominantly on vision to detect targets, yet other senses may cue their sense of sight. Contrarily, most Army combat simulations employ only visual cues. The focus of this thesis is to enhance combat simulations by providing a method by which computer-generated entities can detect and locate objects via a phenomenon known as "sound localization." The Auditory Detection Program is used to represent a human's hearing, and data from a sound localization experiment are analyzed to determine how to best represent the event in which an individual hears a sound and then estimates the location of the sound's source. The resulting algorithms are coded into the Army's combat simulation, COMBAT<sup>XXI</sup>, and the "face-validation" method is used to determine if the algorithms enhance the realism of the simulation. The data analysis consists of Shapiro-Wilks Tests for Normality, Friedman's Tests for Randomized Block Experiment, and Wilcoxon Rank-Sum Tests using the Bonferroni Correction. Implementing this model in COMBAT<sup>XXI</sup> improves the simulation by making it more realistic.

**KEYWORDS:** Modeling, Algorithm, Behavior, Sound Localization, Sound Propagation, Auditory Detection, Combat Models, Hearing, Soldier Representation, Auditory Detection Program, COMBAT<sup>XXI</sup>

## **NETWORK SHORTEST PATH APPLICATION FOR OPTIMUM TRACK SHIP ROUTING**

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**Master of Science in Operations Research-June 2005**

**Advisor: Gerald G. Brown, Department of Operations Research**

**Second Reader: W. Matthew Carlyle, Department of Operations Research**

The United States Navy Meteorology and Oceanography (METOC) community routes ships for weather evasion using advanced meteorological modeling and satellite data, but lacks a tool to enable fewer ship routers to make better routing decisions faster. Limited resources and rising costs are impacting the frequency and duration of current Naval operations. The Commander, Naval Meteorology and Oceanography Command has ordered the community to find efficiencies and automation possibilities in order to meet lower manning levels, reduce waste and increase savings. Outside of the Navy, Ocean Systems Incorporated in Alameda, California, developed the Ship Tracking and Routing System (STARS) software package to calculate optimum sea routes based on weather model data. However, METOC ship routers are reluctant to adopt this complex software. To help solve this, authors modeled Optimum Track Ship Routing (OTSR) for U.S. Navy warships using a network graph of the Western Pacific Ocean. A binary heap version of Dijkstra's algorithm determines the optimum route given model generated wind and seas input. The model is tested against recent weather data to verify the model's performance, and to historical divert route recommendations in order to validate against routes developed by OTSR personnel.

**KEYWORDS:** Network, Dijkstra, Shortest Path, Optimum Track Ship Routing

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# OPERATIONS RESEARCH

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## **EVALUATION OF LOGISTICS OPERATIONS COMMAND AND CONTROL CAPABILITY: OPTIMIZATION REVISITED**

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**Master of Science in Operations Research-June 2005**

**Advisor: Javier Salmeron, Department of Operations Research**

**Second Reader: CDR Glenn Lintz, USN, Department of Operations Research**

Logistics Operations Command and Control Capability Concept (LOCCC), developed by Jeff Grelson in 2000, introduces a new distribution principle to combat elements. This concept employs a supporting logistics unit in a general support role and controls it by a unique command center in order to minimize the footprint left by logistics, improve logistic and tactical responsiveness and reduce the “iron mountain” on the battlefield. This thesis revisits the mathematical models and algorithms developed by Major Thomas Lenhardt to model LOCCC. The network topology is preprocessed in order to convert it into an equivalent, simplified network that is computationally tractable with the existing optimization model by using exact and heuristic algorithms. It is shown that the simplifications and enhancements proposed assist in obtaining much faster and better quality solutions than using the original, non-simplified networks. For example, in a ten-minute run, a solution can be obtained that is 98% better in some cases. The model is also applied to a Turkish Infantry Brigade to evaluate LOCCC with the sustainment requirements and transportation assets of the Turkish Army.

**KEYWORDS:** Combat Service Support, Logistics, Logistics Models, Mathematical Programming, Mixed Integer Programming, Optimization, Symmetry Breaking, Transportation, Turkish Army, Turkish Infantry Brigade, Vehicle Routing Problem

## **A TWO-SIDED OPTIMIZATION OF BORDER PATROL INTERDICTION**

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**Master of Science in Operations Research-June 2005**

**Advisor: Gerald G. Brown, Department of Operations Research**

**Second Reader: Alan R. Washburn, Department of Operations Research**

The United States Border Patrol (USBP) is responsible for interdicting unauthorized entry into the U.S. The USBP must decide how to allocate its detection and interdiction assets to maximize the probability of catching illegal aliens along the border. In this research, authors study the case where an infiltrator can observe USBP preparations, and then choose a path into the U.S. The infiltrator’s courses of actions to maximize the probability of escape are defined, and the USBP’s courses of actions to minimize that maximum achievable probability of escape are expressed. This case applies especially well to a signal entry, e.g., a well-planned, one-time smuggling of a weapon of mass destruction. A sample problem is solved for the U.S – Mexican border near Yuma, Arizona.

**KEYWORDS:** Interdiction, Two-Sided Optimization, Search Theory, Border Patrol

## **A TIME SERIES ANALYSIS OF U.S. ARMY OFFICER LOSS RATES**

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**Master of Science in Operations Research-June 2005**

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**Second Reader: LTC Arthur J. Hoffmann, Jr., USA, Army G-1**

Accurate prediction of officer loss behavior is essential for the planning of personnel policies and executing the U.S. Army’s Officer Personnel Management System (OPMS). Inaccurate predictions of officer strength affect the number of personnel authorizations, the Army’s budget, and the necessary number of accessions. Imbalances of officer strength in the basic branches affect the Army’s combat readiness as a whole.

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## OPERATIONS RESEARCH

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Captains and majors comprise a critical management population in the United States Army's officer corps. This thesis analyzes U.S. Army officer loss rates for captains and majors and evaluates the fit of several time series models. The results from this thesis validate the time series forecasting technique currently used by the Army G-1, Winters-method additive.

**KEYWORDS:** Time Series Analysis, Loss Rates, Time Series Forecasting System, TSFS, Total Army Personnel Data Base, TAPDB, Officer Losses

### **GEO-DEMOGRAPHIC ANALYSIS IN SUPPORT OF THE UNITED STATES ARMY RESERVE (USAR) UNIT POSITIONING AND QUALITY ASSESSMENT MODEL (UPQUAM), PART II**

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**B.S., State University of New York at Buffalo, 1991**

**Master of Science in Operations Research-June 2005**

**Advisor: Samuel E. Buttrey, Department of Operations Research**

**Second Reader: David H. Olwell, Department of Systems Engineering**

Maintaining unit readiness and a satisfactory unit "fill-rate" is probably one of the leading challenges of the United States Army Reserve (USAR). This thesis is the second part of a three-part thesis study that was started by LTC Martin Fair in June 2004 to better position USAR units. In his thesis, LTC Fair surmised that demographics matter in terms of Troop Program Unit (TPU) placement and the corresponding unit fill-rate. LTC Martin Fair built a database by joining information from the U.S. Census Bureau, U.S. zip codes, and USAR zip code data. LTC Fair also formulated an initial network flow model and began an implementation of the first of many constraints.

This thesis examines the relationship between unit location and recruiting success. Authors validate LTC Fair's constraint models and develop the Military Occupational Specialties (MOS) data sets that show demographics play an important role in determining the percentage of qualified recruits by MOS and ZIP code.

Another Naval Postgraduate Student, LTC John Brau, will use these data sets to develop the network flow model in the third part of this study. That model will optimize reserve unit readiness by positioning TPUs in market segments that are best able to maximize their fill-rate.

This research provides the USAR a workable model that takes into account factors such as unit positioning and recruit quality, and includes demographic considerations to determine potential recruiting success by MOS and ZIP code.

**KEYWORDS:** Army Reserve, Unit Stationing, Recruiting, Marketing

### **MODELING THE USE OF THE ADAPTIVE JOINT COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR) NODE (AJCN) IN A TACTICAL ENVIRONMENT**

**Krista L. Watts-Captain, United States Army**

**B.S., United States Military Academy, 1996**

**Master of Science in Operations Research-June 2005**

**Advisor: Samuel E. Buttrey, Department of Operations Research**

**Second Reader: Lyn R. Whitaker, Department of Operations Research**

The Adaptive Joint Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Node (AJCN) is a new C4ISR system with four functional capabilities: communications, signal intelligence (SIGINT), electronic warfare (EW) and Information Operations. This thesis evaluates the first three capabilities of the AJCN: communications, SIGINT and EW. Simulation is used as a time- and cost-effective way to model the AJCN's capabilities. Eleven communications and combat effectiveness MOEs are used to evaluate the AJCN's performance. Point of Attack 2, a tactical simulation with an extensive database, is used to replicate the AJCN and UA operations. Results of the analysis show that the AJCN significantly increases friendly detection of enemy forces; significantly decreases average message transmittal time and the number of failed messages; and increases the friendly force's capability to jam and intercept enemy messages.

# OPERATIONS RESEARCH

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**KEYWORDS:** AJCN, Airborne Communications Node, Adaptive Joint C4ISR Node



# MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

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## OCEAN CIRCULATION AND EXCHANGES THROUGH THE BERING SEA: 1979-2001 MODEL RESULTS

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Master of Science in Physical Oceanography-June 2005

Advisor: Wieslaw Maslowski, Department of Oceanography

Second Reader: Stephen Okkonen, University of Alaska

A model is developed and run with sufficiently high resolution (~9 km and 45 levels) and a large enough spatial domain to allow for realistic representation of flow through the narrow and shallow straits in the Bering Sea region. This is potentially important for quantification of long-term mean and time-dependent ocean circulation, and water mass and property exchanges between the Pacific and Arctic oceans. The mean modeled circulation in the Bering Sea is found to be in good agreement with the limited observational data. The Bering Sea Basin, Bering Slope Current and straits on the northern shelf are identified as highly energetic regions based on eddy kinetic energy fields. Some high biological productivity regions of the northern Bering Sea identified in observational studies are coincident with regions of persistently high energy (up to  $2600 \text{ cm}^2 \text{ s}^{-2}$  at mid-depth) throughout the annual cycle. Over a twenty-three year interval (1979-2001), mean transport through Bering Strait is estimated to be 0.65 Sv. Comparison of model results with published observations indicates that ocean circulation is not only variable at seasonal to interdecadal scales, but it is also responsive to short-term atmospheric forcing. Comparison with observations of near-bottom salinity indicates that the model reasonably represents the major water mass properties. The long-term model results for the Bering Sea provide important insights into the ocean circulation and fluxes and they are a useful frame of reference for limited observations that are short-term and/or cover only a small geographic region.

**KEYWORDS:** Oceanography, Modeling, Bering Sea

## BAROCLINICITY, FORCING MECHANISM AND PREDICTION OF CHEMICAL PROPAGATION OF SAN DIEGO BAY AND THEIR EFFECTS ON NAVAL APPLICATIONS

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Second Reader: Steven D. Haeger, Naval Oceanographic Office

Both instantaneous current and chemical propagation predictions are of utmost importance for all littoral naval operations, including diving, amphibious and mine warfare operations. Undoubtedly, the operating limits and environmental thresholds are crucial and highly reliant on the accuracy and precision of the predictions. San Diego Bay is important because it hosts a large part of the U.S. fleet and has special ecological significance.

A hydrodynamic model, the Water Quality Management and Analysis Package (WQMAP), is used to predict the instantaneous currents with various forcing functions (tides, winds and lateral boundary fluxes). A hydrochemical model, the Chemical Management and Analysis Package (CHEMMAP), is used to predict the water contamination and to simulate chemical attacks/accidents in San Diego Bay, which raise considerations regarding public health, economy, ecology or even national security.

# PHYSICAL OCEANOGRAPHY

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The study shows the barotropic nature of San Diego Bay, the slight significance of wind and the vulnerability of a semi-enclosed tidal basin in a possible chemical attack or accident. Simultaneously, it evaluates and uses two models used by the Naval Oceanographic Office (NAVOCEANO).

**KEYWORDS:** Baroclinicity, Forcing, WQMAP, CHEMMAP, Prediction, San Diego Bay, Chemical Propagation, Model Evaluation

## **SENSIBILITY STUDY OF ST. ANDREW BAY RAPID RESPONSE SYSTEM FOR NAVAL APPLICATIONS**

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B.S., French Naval Academy, 1992**

**Master of Science in Physical Oceanography-June 2005**

**Advisor: Peter C. Chu, Department of Oceanography**

**Second Reader: Steven D. Haeger, Naval Oceanographic Office**

Rapid assessment of littoral oceanic physical and chemical conditions has represented a great challenge in recent years. For assessment of physical conditions, time constraints may limit analysis to barotropic approaches. Because rain can be significant in the St. Andrew Bay, Florida, system, fresh water is a prevailing salinity regulator (through ground seepage), even in areas with few rivers. Because of this, studying baroclinicity and forcing mechanisms should provide reasonable guidance in deciding what to ignore or include when modeling areas of interest. In assessing chemical conditions for purposes of national security relevance or hazards to shipping, the release of chemicals used in nearby offshore oil platform should be taken into account.

A coupled hydrodynamic and chemical modeling developed at the Applied Sciences Associates, WQMAP (for hydrodynamic and water quality analysis) and CHEMMAP (for chemical analysis) is used in this study, with WQMAP for evaluating baroclinicity and forcing mechanism impacts and CHEMAP for estimating the consequences of a hypothetical release of chemicals. A stochastic model was applied for determining probable distribution and concentration resulting from release at a given location.

**KEYWORDS:** St. Andrew Bay, Baroclinicity, WQMAP, CHEMMAP, Chemical

# **MASTER OF SCIENCE IN SPACE SYSTEMS OPERATIONS**

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## **MULTI-NATIONAL COOPERATION IN SPACE OPERATIONS**

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**Master of Science in Space Systems Operations-June 2005**

**Advisor: CAPT Daniel Bursch, USA, Space Systems Academic Group**

**Second Reader: Charles Racoosin, Space Systems Academic Group**

This thesis discusses multi-national cooperation in space operations and its dependence on the human component. It includes a discussion of the history of U.S.-Russian cooperation, specifically the Apollo-Soyuz Test Project, the Shuttle-Mir Program and, finally, the origins of the International Space Station (ISS). This thesis goes into detail about the communication process between the International Space Station, the Mission Control Center – Houston (MCC-H), and the Mission Control Center – Moscow (MCC-M) with emphasis on the human component. This thesis further discusses the impact of personal relationships in the daily operation of the International Space Station. Finally, this thesis discusses lessons learned and additional applications where personal relationships can affect multi-national operations.

**KEYWORDS:** ISS, MCC-H, MCC-M, Space Operations



# MASTER OF SCIENCE IN SYSTEMS ENGINEERING

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## ATTITUDE DETERMINATION FOR THE THREE-AXIS SPACECRAFT SIMULATOR (TASS) BY APPLICATION OF PARTICLE FILTERING TECHNIQUES

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**Master of Science in Electrical Engineering-June 2005  
Master of Science in Systems Engineering-June 2005**

**Advisor: Roberto Cristi, Department of Electrical and Computer Engineering**

**Second Reader: David C. Jenn, Department of Electrical and Computer Engineering**

The accurate determination of spacecraft attitude has always been a critical issue in many applications. The presence of imperfect sensors introduces errors in the system and affects the outcome of the mission. One of the most significant sensors is the rate gyroscope. In particular, the rate gyros are known to degrade with time, introducing random noise and bias. This calls for estimation algorithms that process the measured data in order to reduce the effects of the disturbances to a minimum. This research presents an approach that takes full advantage on the nonlinear dynamics and possibly non-Gaussian disturbances. It is based on recent work involving particle filters, where the probability density functions are approximated by a relatively large number of parameters. It is shown that accurate attitude estimation can be obtained with a manageable number of particles.

**KEYWORDS:** Particle Filter, Quaternion Representation, Attitude Determination, Rate Gyroscope, Nonlinear Estimation

## TRACKING HUMAN WALKING USING MARG SENSORS

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This thesis addresses modeling and simulation of the human lower extremities in order to track walking motion and estimate walking distance. The lower extremities are modeled as an articulated object, which consists of rigid bars connected to each other by joints.

This model is tested by using both synthetic and real data. The synthetic data is created based on the main principles of biomechanics. The real data is obtained from the MARG sensors and is processed by the Factored Quaternion algorithm. Next, it is implemented in a simulation program written in MATLAB. The program utilizes a mathematical model that represents the human gait-cycle and is based on the theory of forward kinematics, as well as on the theory of manipulator kinematics.

The simulation program is able to track the motion of the limbs that represent the lower extremities and estimate the traveled distance. Extensive laboratory tests verified the validity of the configuration.

**KEYWORDS:** MARG Sensors, Gait-Cycle, Forward Kinematics, Manipulator Kinematics, Human Walking Simulation, Position Estimation

# SYSTEMS ENGINEERING

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## **ELECTRONIC ATTACK AND SENSOR FUSION TECHNIQUES FOR BOOST-PHASE DEFENSE AGAINST MULTIPLE BALLISTIC THREAT MISSILES**

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**Murali Tummala, Department of Electrical and Computer Engineering**

The first objective of this thesis is to investigate the effect of several forms of electronic attack (EA) on the radio frequency (RF) sensors used within a boost-phase ballistic missile intercept system. The EA types examined include noise jamming, chaff, radar cross section (RCS) reduction and expendable decoys. Effects of the EA methods are evaluated by examining the track position error at the sensor fusion output. Sensor fusion architectures investigated include a weighted average sensor fusion, Kalman-filter-based sensor fusion and joint probabilistic data fusion architecture. A second objective of this thesis is to extend the single-target, single-interceptor analysis and simulation to a multi-target, multi-interceptor scenario to include the formation of an ellipsoidal gating process to correctly correlate the target measurements with the corresponding track file. It is shown that the most effective EA is the use of noise jamming followed by an RCS reduction of the missile body. It is also shown that a properly designed sensor fusion process can effectively mitigate the EA techniques that might be used in a boost-phase intercept scenario.

**KEYWORDS:** Boost-Phase Ballistic Missile Intercept, Modeling, Simulation, Kalman Filtering, Electronic Attack Effects, Proportional Navigation, Radar Cross Section Reduction, RF Sensors, Data Fusion, Decoys, Noise Jamming, Chaff, Gating, Ellipsoidal Gate, JPDA, Data Association, Kill Vehicle

# **MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY**

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## **THE TRIDENT WARRIOR EXPERIMENTATION PROCESS**

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The Chief of Naval Operations defines FORCENet as the “operational construction and architectural framework for Naval Warfare in the Information Age which integrates warriors, sensors, networks, command and control, platforms and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land.” The Trident Warrior experiments are the Navy’s premier FORCENet Sea Trial experiments. The purpose of the Trident Warrior experiments is to provide “speed to capability” and to develop supporting tactics, techniques and procedures.

The purpose of this thesis is to provide a basic overview of the Trident Warrior Experimentation Process. Through a step-by-step analysis, this thesis explains and justifies the many steps required to complete a successful experiment/experimentation campaign.

**KEYWORDS:** Experimentation, FORCENet, Trident Warrior, Sea Trial, NETWARCOM

## **OPTIMIZING BANDWIDTH OF TACTICAL COMMUNICATIONS SYSTEMS**

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**Second Reader: John Osmundson, Department of Information Sciences**

Current tactical networks are oversaturated, often slowing systems down to unusable speeds. Utilizing data collected from major exercises and Operation Iraqi Freedom II (OIF II), a typical model of existing tactical network performance is modeled and analyzed using NETWARS, a DISA-sponsored communication systems modeling and simulation program. Optimization technologies are then introduced, such as network compression, caching, Quality of Service (QoS) and the Space Communication Protocol Standards Transport Protocol (SCPS-TP). The model is then altered to reflect an optimized system, and simulations are run for comparison. Data for the optimized model is obtained by testing commercial optimization products known as Protocol Enhancement Proxies (PEPs) at the Marine Corps Tactical Systems Support Activity (MCTSSA) testing laboratory.

**KEYWORDS:** Protocol Enhancement Proxies, Compression, Caching, Quality of Service, Bandwidth, Optimization, Modeling and Simulation, NETWARS, TCP Over Satellite, Tactical Data Networks, Tactical Networks

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## SYSTEMS TECHNOLOGY

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### **INTEGRATION OF MINI-UAVS AT THE TACTICAL OPERATIONS LEVEL: IMPLICATIONS OF OPERATIONS, IMPLEMENTATION AND INFORMATION SHARING**

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**Master of Science in Systems Technology-June 2005**

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**Second Reader: William G. Kemple, Department of Information Sciences**

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Small units maneuvering on the battlefield have little time to establish data links and interface with the Global Information Grid (GIG) while trying to achieve an objective. The bandwidth and interface requirements necessary to receive live data from current strategic level systems limit the small unit operational user's ability to receive and act upon data and intelligence. Without the ability to interface with current strategic-level UAV assets, these small units are left without a comprehensive operational picture. Mini-UAVs offer the capability for the tactical user, in a variety of missions, to have direct control over the aerial asset without intervention from higher authority. Organic UAV assets can be used to collect data relevant to small units without the need for connecting to intelligence systems. This offers increased mobility and a dedicated collection platform; however, there are still drawbacks to this capability. This thesis examines mini-UAVs, and their integration into the Coalition Operating Area Surveillance and Targeting System (COASTS) network.

**KEYWORDS:** COASTS, Mini-UAVs, Command and Control, Computers, Communications, Intelligence, Surveillance, Reconnaissance, COTS, Commercial-Off-the-Shelf Technology, Local Persistence

### **ENHANCING THE EXTENDED AWARENESS CAPABILITY OF THE EXPEDITIONARY STRIKE GROUP (ESG): INTEGRATING SHOTSPOTTER AND CURSOR TO TARGET TECHNOLOGIES WITH UNMANNED AERIAL VEHICLES TO ENHANCE THE MISSION CAPABILITY OF THE ESG**

**Thomas J. Gibbons, Jr.-Ensign, United States Navy**

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**Master of Science in Systems Technology-June 2005**

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**Second Reader: William G. Kemple, Department of Information Sciences**

This thesis discusses two emerging technologies and how their integration with UAVs can improve the situational awareness capability of the Expeditionary Strike Group. Shotspotter is an acoustic gunshot detection system and Cursor on Target is an XML-based schema to enhance information exchanges. When integrated with UAVs, these two technologies will drastically improve an ESG's efficiency and lethality in combat.

**KEYWORDS:** Shotspotter, Cursor on Target, CoT, Unmanned Aerial Vehicles, UAV, Expeditionary Strike Group, ESG

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## SYSTEMS TECHNOLOGY

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### **DEPLOYABLE NETWORK OPERATIONS CENTER (DNOC): A COLLABORATIVE TECHNOLOGY INFRASTRUCTURE DESIGNED TO SUPPORT TACTICAL SENSOR-DECISION MAKER NETWORK OPERATIONS**

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**David Netzer, Center for Defense Technology and Education for the Military Services**

The coordination and collaboration of information has never before been more important to the success of tactical missions. Hybrid wireless-mesh networks have the capability to put critical information at the fingertips of the operator, enabling tactical units to successfully carry out their missions. The increasing use of expeditionary and special operations forces operating in ad hoc, dynamic and tactical environments poses a need for an adaptable, flexible and responsive Deployable Network Operations Center (DNOC) to support their efforts. Whether co-located or virtual, the DNOC must supply tactical units with the right information, at the right time and in the right format. The DNOC must also serve as a rapid, reliable and secure communications network platform so that forces can collaborate in a manner that builds quality interactions and trust. This thesis effort consists of designing, building and implementing a DNOC to support the Naval Postgraduate School's Tactical Sensor-Decision Making Network (TSDN) field experiments. Baseline operating processes are explored and recommendations for life-cycle maintenance and future upgrades are made.

**KEYWORDS:** Information Systems Technology, Common/Consistent Tactical Picture

### **DEVELOPING A FLY-AWAY-KIT (FLAK) TO SUPPORT HASTILY FORMED NETWORKS (HFN) FOR HUMANITARIAN ASSISTANCE AND DISASTER RELIEF (HA/DR)**

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**Master of Science in Systems Technology-June 2005**

**Advisors: Alexander Bordetsky, Department of Information Sciences**

**Brian Steckler, Department of Information Sciences**

**Second Readers: Rex Buddenberg, Department of Information Sciences**

**Brian Fila, Office of the Secretary of Defense, Networks and Information Integration**

This research discusses developing a Fly-Away-Kit (FLAK) to support the forming of Hastily Formed Networks (HFNs) in remote areas in support of Humanitarian Assistance and Disaster Relief (HA/DR) operations. The initial focus is on the requirements, situation, area of operations and mission. Different definitions and perspectives emerge when an individual mentions HFNs, HA/DR and Complex Humanitarian Disasters (CHDs). It is the author's intention to define and describe both an HFN and a CHD in order to justify the need for the FLAK. This process also defines the requirements for the FLAK and facilitates processes for ensuring that those requirements are met.

The personnel responding to the attacks of September 11, 2001, and the December 26, 2004, Southeast Asia Tsunami suffered Command and Control (C2) and information challenges. Even more challenges are being currently addressed by homeland defense, maritime domain awareness and non-governmental organizations (NGOs) abroad. From the top down, levels of administration are developing new plans, procedures and organizations that will improve the security and communication processes of the nation. A global, broadband, rapidly deployable network node complete with Internet reach-back, voice, data and video capability is of the utmost importance to enable C2 and Network Centric Operations (NCO). Undoubtedly, commercial and military organizations, traditional or new, will greatly benefit from this capability. The U.S. Department of Defense (DoD) is particularly interested in improving interaction, coordination, communications and operations when DoD and other entities respond simultaneously to natural or man-made CHDs.

**KEYWORDS:** Hastily Formed Networks, HFN, Rapid Deployable Networking, Mobile Command Center, Ka, L Band, VSAT, 802.16, OFDM, 802.11, MESH, VoIP, C2PC



**MASTER OF ARTS**

**National Security Affairs  
Security Studies**



# **MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS**

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## **INTELLIGENCE ARCHITECTURE IN THE HUNGARIAN SPECIAL OPERATIONS FORCES**

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**Master of Arts in National Security Affairs-June 2005**

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Based on the challenges of the new global security environment, Hungary conducted a strategic Defense Review, which served as the basis of a reform of the Hungarian Defense Forces (HDF). One of the consequences of this reform is that the Hungarian Government has directed the establishment of a Special Forces group within the HDF. The government based this decision on an examination of the current security environment, likely threats, and its responsibilities as a member of NATO and the European Union.

Recent experience has shown that in the GWOT one of the most important requirements is information dominance. Information gathered by human intelligence becomes even more important in asymmetric warfare. The role of the SOF in the collection of important information in theater requires a robust intelligence architecture at the unit level. The final goal should be the complete integration of SOF-based intelligence into the national intelligence community, both as an information provider and as an information user. The aim of this thesis is to address the importance of the proper intelligence structure within the Hungarian SF unit, especially in the current global security environment, as well as its cooperation with other intelligence agencies in the global war on terrorism.

**KEYWORDS:** Hungary, Special Operations Forces, Intelligence, Global War on Terror, GWOT

## **NATO TRANSFORMATION: PROSPECTS FOR AND CONSTRAINTS ON BRIDGING THE CAPABILITY GAP**

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**Second Reader: Paul Pitman, DoD Contractor**

The thesis analyzes the capability transformation process of NATO to measure the progress made by the European NATO member states in narrowing the capability gap between the United States and European forces. Since the end of the Cold War, the capability gap among the NATO members has become a major concern because it hinders NATO's operational ability. Operation Allied Force and new strategic and operational challenges of the 21<sup>st</sup> century have driven NATO's capability transformation process. The thesis analyzes NATO's military capabilities exhibited in Operation Allied Force by analyzing the individual national contributions of the Allies to highlight the imbalance in the capabilities of the Alliance. The thesis then examines the capability transformation process regarding the commitments made by the Allies at the Washington, Prague and Istanbul Summits to reinforce capabilities for modern warfare in high threat environments and narrow the growing capability gap. It focuses on the decisions and achievements of each summit to measure the progress made by the European NATO member states in bridging the capabilities gap between the United States and European forces. To do this, it analyzes military expenditures, defense capabilities, national regulations and strategies that slowed down or reinforced the capability transformation process. The conclusion is that, despite encouraging trends in the capability transformation process, the balance in the military capabilities continues to favor the United States by a wide margin.

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**KEYWORDS:** NATO, Military Capability Transformation, Operation Allied Force, Defense Capabilities Initiative, Prague Capability Commitments

**THE EAGLE, THE BEAR, AND THE YURT: EVALUATING KYRGYZSTAN'S FOREIGN  
POLICY BEHAVIOR WITH THE UNITED STATES AND RUSSIA IN THE POST-9/11  
SECURITY ENVIRONMENT**

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The U.S.-led War on Terrorism necessitated engagement strategies with several small states. The policy motivations of small states, however, are often overlooked. Kyrgyzstan is an interesting case as it offered an airbase for the U.S.-led campaign in Afghanistan, but also offered a similar arrangement to Russia. Thus, the motivation of the small state, Kyrgyzstan, is being evaluated in its engagement with two larger powers. This thesis argues that small state motivation revolves around how the state perceives the world it lives in. If the small state perceives a realist world, its behavior is commensurate with the capacity of small states in realist worlds. This leads to bandwagon behavior with larger powers, or balancing with larger powers against internal threats. If the small state sees a complex interdependent world, then it uses what power it does have, such as offering access to airbases, to leverage other benefits. Insight into small state perceptions allows U.S. policy makers to make realistic goals when formulating strategies with smaller countries. The data suggests Kyrgyzstan perceives itself to be in a moderate realist world, pursuing policies to solidify its relationship with Russia while opportunistically reaping any short-term benefits from the United States.

**KEYWORDS:** Kyrgyzstan, Central Asia, Small States, U.S.-Kyrgyz relations, Russian-Kyrgyz Relations

**EMERGING THREATS AND THE WAR ON TERRORISM: THE FORMATION OF RADICAL  
ISLAMIST MOVEMENTS IN SUB-SAHARAN AFRICA**

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**Master of Arts in National Security Affairs-June 2005**

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Determining the conditions that lead to the formation of radical Islamist groups will help analysts and policy-makers prioritize countries within sub-Saharan Africa that may need monitoring to prevent the onset of indigenous terrorism. This thesis attempts to produce knowledge toward that end by determining causal variables hypothesized to be associated with radical Islamist group formation through inductive analysis. A narrative describing the formation of a radical Islamist movement in Kano, Nigeria, is compared against a narrative describing the conditions in Zanzibar City, Tanzania, where radical groups have not formed. The goal of the thesis is to generate an initial understanding of the underlying conditions that cause radical group formation to help tailor U.S. policy goals toward fighting radical Islamist group emergence through prevention.

**KEYWORDS:** Terrorism, Africa, Sub-Saharan, Nigeria, Tanzania, Kano, Zanzibar, Islam, Islamist, Radical

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## **THE HOUSE THAT PUTIN BUILT**

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Robert E. Looney, Department of National Security Affairs**

The purpose of this thesis is to explore in what direction President Putin is attempting to drive the Russian economy. Now that Russia is past its initial transition phase, this thesis addresses the question of whether or not Russia has the necessary elements in place to ensure its success as a market economy. In order to answer this question, this thesis considers the roots of economic change within Russia, starting with the Gorbachev era. The rule of law is also explored and how it affects the stability of the Russian market. The Yukos case is used to serve as a marker for the establishment of the rule of law as it transcends all eras, starting with Gorbachev and culminating under Putin. The main argument is that President Putin inherited a state rife with corruption and controlled by a select few who would steer the economy in order to further their own self-interest. Even though Putin was constrained by the legacy of the past, he has taken actions to counter corruption and keep Russia on the path of economic reform through “managed capitalism.” However, he has fallen short of building the institutions necessary to create a transparent market economy.

**KEYWORDS:** Russia, Economic Reform, Transition, FDI, Oligarchs, Gorbachev, Yeltsin, Putin, Yukos, Khodorkovsky

## **TUDO PELA PATRIA: THE BRAZILIAN NAVY’S DRIVE TO BLUE WATER**

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**Advisor: Harold A. Trinkunas, Department of National Security Affairs  
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The Brazilian Navy is unique among most world navies today. Since the end of the Cold War, most nations have reduced their naval power, yet Brazil has maintained a determination to possess a blue-water fleet. Brazil is also attempting to assert itself as the regional power in South America, in this case through the development of a modern yet modest naval force capable of projecting power beyond its shores.

This thesis seeks to explore Brazil’s recent naval expansion through three points of view. First, Brazil is seeking possession of a blue water naval force as a likely means for it to achieve greater power and prestige amongst other powerful states in the world. Second, Brazil aspires to a permanent seat on the United Nations Security Council, and is expanding its fleet to increase its chances of being chosen. Finally, domestic politics also have a great effect on Brazil’s current drive to blue water. Creation of the civilian-led defense ministry, the expensive SIVAM surveillance system and general public sentiment all work to favor naval expansion.

The thesis concludes by summarizing the three arguments and stating that each of the three arguments have collectively contributed to Brazil’s naval expansion.

**KEYWORDS:** Brazil, Naval Power, Brazilian Navy, SIVAM, United Nations

## **THE MEDIA AND DEMOCRACY IN RUSSIA**

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This thesis considers the evolution of the Russian media and assesses the decrease in media freedom and its effect on Russian democracy. The Russian media has lost most of its freedom and ability to report critically over the last five years. Although there are Russian laws that are supposed to protect the freedom

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of the media, those have not been enforced. In addition, over the last five years a number of reforms have occurred that have removed some of those freedoms. These include laws that restrict coverage of elections, terror events and the Chechen region. The lack of freedom has resulted in an inability of the media to serve their purpose in civil society. This has contributed to the civil society's lack of ability to ensure that Russia's government remains democratic. If present trends continue, the future does not look good for Russian democracy or the freedom of Russia's media.

**KEYWORDS:** Russia, Democracy, Media

### **POLISH FOREIGN AND SECURITY POLICY: DILEMMAS OF MULTI-NATIONAL INTEGRATION AND ALLIANCE COHESION, 1989-2005**

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**Master of Arts in National Security Affairs-June 2005**

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**John C. Leslie, Department of National Security Affairs**

In the post-9/11 era, U.S. and European security interests have diverged. During the lead-up to the war in Iraq, this became unmistakable when the Europeans, Germany and France especially, suddenly began to question the nature of the terrorist threat and the militaristic U.S. approach to it. Despite this fact, and its impending EU membership, Poland sided with the U.S. While it was the subject of extensive criticism from its future EU patrons, the Polish government appeared oblivious to the potential that its long-held desire to enjoy the benefits of its ties with both Europe and the U.S. was now jeopardized by the rift between the two. In an uncertain world and among the new threats post-9/11, the Republic of Poland found itself confronted with the prospect of having to choose, for the first time, between its close relationship with the United States and its European ties. Despite Poland's participation in the War in Iraq and its initial steadfast opposition to the EU constitution, the apparent atlanticist foundation of Poland's security policy is only a temporary necessity. Poland will eventually fully return to Europe, where its economic and political interests already lie, and its security will be.

**KEYWORDS:** Poland, European Union, North Atlantic Treaty Organization, Security, U.S., EU Constitution

### **CHINA'S MARITIME SILK ROAD TO OIL: PROSPECTS FOR CHINESE INFLUENCE IN THE MIDDLE EAST THROUGH NAVAL MODERNIZATION**

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**Second Reader: Kalev Sepp, Department of Defense Analysis**

This thesis explores the prospect of a PRC naval role in the Persian Gulf by 2025 and its implications for the United States Navy, focusing in particular on Beijing's evolving relationship with Iran. Since the last years of the Cold War, China's relationships with the United States and Russia have improved significantly, and China no longer sees these former adversaries as imminent threats. As a result, the People's Liberation Army (PLA) has shifted its strategy from a defensive posture to a forward-looking one. Concurrently, economic developments and progress have raised China's aspirations to become the new regional power in Asia. As such, the PRC's economic sustainability will depend greatly on imported oil. The Persian Gulf will be a strategic focus for China in the near future.

**KEYWORDS:** Implication, Chinese Naval Modernization, People's Liberation Army-Navy, Iran, Persian Gulf

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### **CLOSE AIR SUPPORT (CAS), INTERDICTION, AND ATTACK HELICOPTERS**

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**Second Reader: James A. Russell, Department of National Security Affairs**

Within days of a major failed strike by attack helicopters during Operation Iraqi Freedom (OIF), analysts were questioning the value of such platforms on the modern battlefield. As OIF moved from combat to stability operations, helicopter losses from enemy action actually increased, seemingly strengthening the argument of those who see the helicopter as unsuitable to some combat operations.

Attack helicopter operations have diverged into two distinct categories, interdiction and close air support (CAS), since their inception. This thesis argues that attack helicopters are most suited to perform CAS while their employment in interdiction is problematic at best. Doctrine, tactics and threat are studied as they applied in the Soviet-Afghan War, Desert Storm and OIF in order to examine the issue across a range of time and types of warfare.

**KEYWORDS:** Afghanistan, AH-1W Super Cobra, AH-64 Apache, Attack Helicopter, CAS, Deep Attack, Desert Storm, Doctrine, Interdiction, Iraq, MANPAD, MI-24 Hind, Mujahideen, Operation Iraqi Freedom, SEAD, Task Force Hawk, U.S. Army, U.S. Marine Corps

### **PAKISTAN'S GWADAR PORT – PROSPECTS OF ECONOMIC REVIVAL**

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**Second Reader: Feroz Hassan Khan, DoD Contractor, 2020 LLC**

Pakistan is building a port at the southwestern city of Gwadar on the mouth of the oil rich Persian Gulf. It provides an economical route for the flow of Central Asia's natural resources to the world, along with easy access to the growing consumer markets of Asia. This thesis conceptualizes the Gwadar facility as a hub port that will contribute significantly to the revival of Pakistan's economy. China mainly funded and completed the first phase of the Gwadar port in 2005. Islamabad is presently negotiating with private investors for the construction of the second phase. This thesis demonstrates the necessity of a white paper promulgating policies to attract foreign investment. The United States and key regional players are likely to view Chinese involvement in the Gwadar port project with suspicion. Any potential Chinese long-term military presence in the region will pose complications for Pakistan. The United States may request military basing rights at the Gwadar port to handle some future turbulent situation in the region. Any such eventuality would require Pakistan to strike a difficult balance between a time-tested friend and an ally. Pakistan must enunciate a policy of non-military use of the Gwadar port for foreign powers to help stimulate Pakistan's economic revival.

**KEYWORDS:** Pakistan, Gwadar Port, Indian Ocean, Maritime, Oil Pipe Line, Central Asia, Pakistan's Economic Revival

### **PAKISTAN'S AFGHANISTAN POLICY**

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Relations between Pakistan and Afghanistan have remained estranged mainly due to Afghanistan's revanchist claim about Pakistan's western province and its non-recognition of the Durand Line as the

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international border. With a hostile India to the East, Pakistan can ill-afford another irredentist neighbor. Since 1947, both countries have interfered in each other's domestic affairs. The Soviet invasion of Afghanistan forced Pakistan to wage a proxy war in Afghanistan, garnering the support of Western and Arab allies. Since the end of Cold war, Pakistan has continued its forward policy in Afghanistan through support of the Taliban. Its prime security interest in Afghanistan remains having a friendly government in Kabul.

After the September 11, 2001, attacks, Pakistan abandoned support of the Taliban and joined the U.S.-led coalition to destroy the Al-Qaeda in Afghanistan. Once again, Pakistan encountered a deep-seated hostility, this time from the Northern Alliance, which dominates the new power structure in Kabul. Skepticism and fear remain as both countries move cautiously to revitalize bilateral ties.

This thesis analyzes Pakistan's Afghanistan policy from 1947 to 2001. It recommends Pakistan's effective engagement with Afghanistan. While Pakistan protects its legitimate security interests, it must refrain from actively interfering in Afghanistan's political future. The thesis also recommends that the United States should substantively remain engaged in Afghanistan to stabilize the region, assist with the reconstruction of Afghanistan, ensure non-interference of regional actors and finally, and most importantly, help settle the Durand Line issue once and for all.

**KEYWORDS:** Pakistan, Afghanistan, United States, Foreign Policy, National Security Affairs, South Asia, Taliban

### TRANSATLANTIC RELATIONS – ARE ALLIANCES A FUNCTION OF AN EXTERNAL THREAT

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Current European-U.S. transatlantic relations represent the heritage of a large number of international alliances and institutions that were founded at a time when there was a bipolar world, a world dominated by the United States and the Soviet Union. Today, fourteen years after the end of the Cold War, some national leaders question the continued viability of these international alliances and institutions. In their references to international relations, realist and liberal theorists reflect significant ideological differences, which have considerable influence on transatlantic relations. This thesis considers a central question pertaining to the future of transatlantic relations between Europe and the United States: Will the presence, or absence, of an external threat to the countries involved be the deciding factor in their willingness to cooperate in security alliances? It is a significant question, and investigating it provides a better understanding of future uses of alliances and their role in world politics. Recently, two specific historical occurrences decisively modified the security landscape worldwide: the end of the Cold War 1991, and almost two decades of violent, deadly acts of international terrorism. Since the breakdown of the Warsaw Pact in 1991 and the dissolution of the Soviet Union, which made former satellite states suddenly independent, numerous eastern European countries have applied for membership in NATO and the European Union. At the same time, organizations such as, especially, the EU and NATO, have had to deal with the competitive and often contradictory interests of member states. This thesis emphasizes France, Germany and United States because the differences in their positions inside NATO are most significant.

**KEYWORDS:** External Threat, Transatlantic Relations, European Union, Threat Perception, European Security Strategy, Future of NATO

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## THE CONVENTIONAL ARMED FORCES IN EUROPE TREATY AND ITS CONTRIBUTION TO EURO-ATLANTIC SECURITY AFTER 1990

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This thesis examines the influence of the Conventional Armed Forces in Europe Treaty (CFE) on security in the European Continent after 1990. This study analyzes and describes the origins of the CFE treaty and its development from the late 1990s until signing the CFE agreement during the Conference on Security and Cooperation in Europe, which took place in November 1990 in Paris. In the history of Europe, the 1990s appear as a turbulent time. The end of the Cold War, collapse of communistic governments in some European countries and efforts of certain states toward NATO membership created a specific background during which armed forces reductions were formulated by the leading powers.

This thesis further analyzes the relationship between NATO and the CFE treaty and their mutual cooperation, and describes the approach of selected countries toward the CFE settlement. It also describes the new strategic shape of Europe influenced directly by resolutions of the CFE treaty. However, this agreement should not be viewed as unanimous. The outcome was not achieved easily. Even after November 1990, there was still disagreement within certain nations concerning treaty decisions. Therefore, the main part of thesis focuses on usefulness of the CFE treaty in contemporary European security mechanisms.

**KEYWORDS:** Security, Europe, Treaty, Arms Control, Verification, CFE, NATO, Armaments, Inspection

## NATO AND FORWARD DEFENSE: AN ANALYSIS OF EXPEDITIONARY CAPABILITIES AND OUT-OF-AREA SECURITY

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This thesis examines NATO's adaptation of a new security focus towards forward defense in the 21<sup>st</sup> century. Until the late 1990s, the strategic focus of NATO was on mutual defense based on a collective response guaranteed by Article 5 of the Washington Treaty. Since the adoption of NATO's Strategic Concept (1999), the Alliance has shifted their strategic focus toward a forward defense strategy. As NATO assumed more operational responsibilities, and deployed forces out-of-area in non-Article 5 missions, the disparity of military capabilities, operational challenges, and cultural and institutional differences within the Alliance gave rise to the question, "Is NATO the most effective instrument with which to execute a strategy of forward defense?"

A review of the expeditionary campaigns in the Balkans, Afghanistan and Iraq determines the efficiency of the Alliance as an expeditionary security actor. The modernization of European military capabilities are described in relation to NATO, and how these programs either complement or duplicate existing structures and capabilities. Furthermore, inherent structural flaws in NATO's composition are examined, as well as cultural and ideological differences within the Alliance and their effects on out-of-area operations. Finally, challenges and issues that may confront NATO in the future during the execution of their forward defense strategy are discussed.

**KEYWORDS:** NATO, Non-Article 5 Missions, Forward Security, Out-of-Area Intervention, Transformation, Military Capabilities, NATO Strategic Concept, National Security Strategy, European Security Strategy, European Union, ESDP, NATO Reaction Force, Petersberg Tasks, Prague Capabilities Commitments

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### **POLISH ACCESSION TO NATO: INTERNATIONAL RELATIONS, NATIONAL INTERESTS, AND PERSONALITIES OF ALLIANCE REFORM, 1979-1999**

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After the end of the Cold War and the collapse of communism in Poland, the main goal for the Polish nation was integration into the Western collective security organizations. Poland's democratically elected politicians initiated a process that aimed at NATO membership for Poland. The first steps included adjustment of Polish civil-military relations, diplomatic efforts to push for early inclusion and the adoption of a democratic constitution. Polish determination, in conjunction with the U.S. steps influencing NATO decision-making to enlarge the Alliance finally resulted in NATO inclusion of Poland in 1999. This thesis seeks to determine which forces, events and personalities contributed to Poland's NATO membership. Moreover, this thesis is a useful example for future potential NATO members, such as Ukraine and Croatia, in their applications for NATO membership. The steps that Poland took to comply with NATO requirements, as well as the manner in which Polish diplomats pushed for enlargement, could be used as an example to follow. Additionally, descriptions of the United States' and other NATO members' policies and contributions to NATO enlargement will allow for understanding of the importance of the organization.

**KEYWORDS:** Lech Walesa, Aleksander Kwasniewski, Bill Clinton, Boris Yeltzin, Helmut Kohl, NATO Enlargement, PfP, Polish, American, German and Other Allies Engagement in NATO Enlargement

### **21ST CENTURY TERRORISM: WRONG DIAGNOSIS, INADEQUATE REMEDY**

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From the early 1990s, and especially since September 11, 2001, numerous scholars, politicians and political analysts alike have characterized terrorism as global, religious, irrational and rising. The theory of the emergence of this "new terrorism" is well established and can be considered as conventional wisdom. The main characteristics of the "old terrorism," its political, local and rational character, are obsolete in accordance with this line of thinking. In particular, Al Qaeda is thought to be an enemy worth changing the National Security Strategy of the United States and even suspending some civil, not to mention human, rights. However, the decline or disappearance of many prominent terrorist figures or entire groups have been ironically overlooked, or selectively ignored as irrelevant to the "new" terrorism. This thesis challenges the aforementioned common knowledge and suggests that the "new terrorism" has very few, if any, differences from the "old" one. It remains a purely political, mainly local and definitely rational activity in a steady or declining stage.

**KEYWORDS:** Terrorism, Al Qaeda, Religious, Global, Irrational, Political, Counter-Terrorism, Policy, Misconceptions

### **THE DURAND LINE: SOUTH ASIA'S NEW TROUBLE SPOT**

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The Durand Line, the western border between Pakistan and Afghanistan, was delineated in 1893 as the boundary between then British India and Afghanistan. The international community has recognized the

Durand Line as the Pak-Afghan border since the creation of Pakistan in 1947, but successive Afghan rulers have repudiated its legitimacy. This dispute has caused turbulence in relations between these countries and instigates greater problems with regard to Pashtun nationalism. The Durand Line has remained porous due to the nature of tribal cultures and the socio-economic compulsions of the people living along the Durand line. The Durand Line was exploited to launch the Afghan Jihad against the Soviets in the 1980s. The GWOT in Afghanistan has once again brought misperceptions regarding alignment, and the porous nature of the Durand Line to the limelight.

This thesis demonstrates that existing combat operations against Al-Qaeda and the Taliban and the exploitation of the Durand Line by the U.S.-led coalition forces, had a destabilizing effect on Pakistan, due to the autonomous nature of tribal areas and Pakistan's necessity to extend its authority in tribal areas while supporting the GWOT. This thesis recommends that a clear understanding of the Durand Line as an international border by all concerned states will enhance the coordination of operations at all tiers, and thereby prevent this border from becoming South Asia's next trouble spot.

**KEYWORDS:** Pakistan, Afghanistan, The Durand Line, Pashtunistan, Pak-Afghan Relations, Role of International and Regional Players in South Asia, FATA, NWFP and Operations Against Al-Qaeda and Taliban in Afghanistan and Pakistan, GWOT, India and Afghanistan

### **CIVIL-MILITARY RELATIONS IN THAILAND: MILITARY AUTONOMY OR CIVILIAN CONTROL?**

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This thesis, addresses the level of civilian control over a once politically dominant Thai military. The thesis starts by presenting a history of the evolving political role of the Thai military, from the overthrow of the absolute monarchy in 1932 to the events of Black May in 1992. After discussing the events from 1992 until the present, the thesis focuses on the three main enablers for greater civilian control of the military: economic development, political parties and the monarchy. Three different periods in Thailand's political development are analyzed to determine trends in the level of military autonomy and civilian control. A trend of greater civilian control is found in both the political and institutional realms dating from the Prime Minister Thanom period (1963-1973) to Prime Minister Thaksin's administration (2001-2005). Finally, the thesis recommends policy proposals for the United States to implement to assist Thailand in consolidating gains made in democratic, civilian control of the military.

**KEYWORDS:** Civil-Military Relations, Thai Military, Thai Politics

### **THE ROLE OF THE ULAMA IN SHIITE SOCIAL MOVEMENTS: BAHRAIN, LEBANON, AND IRAQ**

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The Shiite *ulama* have become politically active in past decades, beginning in the 1960s-70s with the articulation of the new ideology that empowered the Iranian Revolution. Though a significant portion of the *ulama* retained their quietist tradition, enough felt motivated by *wilayet e-faqih* to become a major force in the political landscape. The *ulama* were particularly well suited to lead a successful social movement. Shiite tradition and symbology, once released from the bonds of quietism, were perfectly suited to motivate a struggle for justice. Despite the *ulama*'s successful leadership, they are most influential when they are part of an underground opposition movement. The three case studies demonstrate that when movements reach a certain level of success, the *ulama* tend to retreat back to their studies. While many significant

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*ulama* continue to pay lip service to the *wilayet e-faqih*, many have also admitted that it is not practical in their country's particular circumstance. This is not to say that they are not influential, but that they prefer to let others perform daily political tasks. The scowling, turbaned *'alim* is not necessarily the uncontrolled voice of radicalism bent upon founding an Islamic state.

**KEYWORDS:** Shiite, Ulama, Clerics, Social Movement Theory, Iraq, Bahrain, Lebanon, Iran, Hezbollah, al-Da'wah, Khomeini, Fadlallah, Baqir al-Sadr, Sistani, Kho'i

### **BAPTISM OF FIRE FOR THE EUROPEAN SECURITY AND DEFENSE POLICY: WILL THE EUROPEAN FORCES SUCCESSFULLY IMPLEMENT THE DAYTON ACCORDS?**

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The war in the Balkans (1991-1999) dramatically demonstrated the European dependence on the United States in military issues. The EU was paralyzed by the events in the Balkans and showed a startling incapacity to deal with this crisis. Even in 2005, some critics argue that, though the European Union (EU) has become an economic superpower, it is still a negligible player in the realm of security and defense issues. This thesis demonstrates that since 1998 the EU has developed a credible security and defense policy, and the capabilities and the mindset to successfully conduct military missions. The thesis argues that the EU forces, EUFOR, will successfully implement the 1995 Dayton Accords in Bosnia and Herzegovina in the wake of NATO's Implementation and Stabilization Forces (IFOR/SFOR).

Following an overview of the development of the European Security and Defense Policy (ESDP), the thesis highlights how the ESDP was put into practice for the first time during operation CONCORDIA in Macedonia in 2003. The thesis further examines the challenges that EUFOR has to face in Bosnia and Herzegovina today and it outlines the ways and means that the EU and EUFOR chose to deal with the challenges in the country. The thesis summarizes the findings to show how they support the argument that EUFOR will successfully implement the Dayton Accords and the implications of the topic for ESDP more generally.

**KEYWORDS:** European Union, EU, European Security and Defense Policy, ESDP, European Union Forces, EUFOR, Bosnia and Herzegovina, BiH, Dayton Accords, ALTHEA, CONCORDIA, Berlin Plus, NATO

### **UNDERSTANDING IRAQ'S SHI'IS: EVOLVING MISPERCEPTIONS WITHIN THE U.S. GOVERNMENT FROM THE 1970S TO THE PRESENT**

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This thesis explores shifting perceptions within the U.S. Government regarding Iraq's Shi'i majority, and their impact on the decision to remove Saddam, and on current U.S. endeavors in post-war Iraq. It explains how perceptions of Shi'is as a radical, monolithic, anti-American sect were formulated during the late 1970s and 80s, as the U.S. Government assumed a dominant role in the Middle East following Britain's withdrawal. During that time, Shi'is were viewed as a significant threat to U.S. regional interests, and for over 20 years, U.S. policy has sought to contain them. These perceptions changed dramatically prior to Operation Iraqi Freedom, in a manner that seemed to support U.S. objectives for a post-Saddam Iraq. The Bush administration now believes that Iraq's Shi'is were unified, supportive of a long-term alliance with the U.S. Government and amenable to an imposed secular democracy that would be friendly with the West. In the aftermath of the war, such misperceptions are becoming increasingly obvious. This thesis identifies and corrects these errors, and explains how these shifts in viewpoint occurred. Furthermore, the

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importance of understanding Iraq's Shi'is will be underscored by positing that the Shi'i are an essential element to any viable, long-term solution for post-war Iraq.

**KEYWORDS:** Iraq, Shi'i, Shiites, Terrorism, U.S. Misperceptions, Global War on Terrorism, Operation Iraqi Freedom

### **NAVAL MINES IN THE 21<sup>ST</sup> CENTURY: CAN NATO NAVIES MEET THE CHALLENGE?**

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In this thesis the author argues that the threat posed by naval mines to NATO forces has increased as the proliferation of advanced mine technology has increased and as NATO finds itself participating in more security operations at home and abroad. Global proliferation of sea mines, both older variants and advanced new designs, has continued to grow and presents a unique challenge to maritime security. NATO naval forces must be prepared (through sustained and balanced development and fielding of dedicated and organic MCM capabilities) to counter the danger posed by naval mines and to ensure that vital sea lines of communication (SLOCS), strategic chokepoints throughout the world, and commercial ports and naval bases remain open and uncontested.

**KEYWORDS:** Mine Countermeasures, MCM, Organic Mine Countermeasures, OMCM, Proliferation, Littorals, North Atlantic Treaty Organization, NATO, NATO Response Force, NRF

### **INDIGENOUS COMPETITION FOR CONTROL IN BOLIVIA**

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Bolivia's indigenous groups achieved an unprecedented level of political power in the latter half of the twentieth century. Traditional explanations for this phenomenon (elite alliances, deprivation, matter-of-time) have proven insufficient. This thesis argues that the ascendancy of Bolivia's groups can be best understood through the application of organization and social movement theories, and it uses the political economy framework as a backdrop. Data are drawn from scholarly analyses, official documents and historical texts. This thesis concludes that Bolivia's indigenous movement is not a single movement, but a coalition of many social movements. It demonstrates that ethnicity frameworks have in some cases hindered the progress of movements because of different understandings of ethnicity. Variegated interests, visions of the future, and geography, have exacerbated these differences. This thesis concludes with recommendations for strategic level policy-makers and tactical level operators.

**KEYWORDS:** Bolivia, Indigenous, Ethnicity, Aymara, Quechua, Guarani, Networks, Social Movement, Insurgency

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### **SPECIAL OPERATIONS FORCES IN THE PEOPLE'S LIBERATION ARMY AND THE DEVELOPMENT OF AN INTEGRAL UNCONVENTIONAL WARFARE MISSION**

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The three objectives of this thesis are to determine, through historical investigation, the primary motivations and impetuses behind the creation and development of special operations forces (SOF) within the People's Liberation Army (PLA) of China; to provide a detailed briefing of modern PLA SOF; and to determine whether PLA SOF contingents will develop an American "Green Beret"-type unconventional warfare (UW) capability in the immediate future.

The third objective is ascertained through a brief investigation of the history, motivations and national strategy behind the United States Army Special Forces. The doctrinal leanings of Local War Under High Tech Conditions, as well as the strategic and political objectives of the People's Republic of China (PRC), and how both factors pertain to and affect the missions of PLA SOF, are examined.

Through the course of this research, it is discovered that doctrinal changes within the PLA, post-1979 PLA modernization and professionalization efforts, financial constraints on regional power projection goals, and the First Gulf War were the primary drivers behind the creation and development of PLA SOF. At present, an integral UW capability within PLA SOF is constrained by the Chinese military's current doctrinal emphasis--fighting a short war--and the PRC's strategic and political goals--translating regional economic interdependence into regional dominance.

**KEYWORDS:** PLA SOF, Unconventional Warfare, "Red Berets"

### **UNITED STATES AND RUSSIAN COOPERATION ON ISSUES OF NUCLEAR NONPROLIFERATION**

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In this thesis, a brief historical synopsis of U.S.-Russian cooperation on issues of nuclear nonproliferation after the collapse of the Soviet Union is presented. This research deals with current programs initiated to foster U.S.-Russian cooperation to prevent nuclear proliferation. Topics discussed include the United States' success and strategy dealing with cooperative efforts with Russia, Russian effectiveness in cooperating with the United States on issues of nuclear nonproliferation, and finally, a conclusion summarizing the findings and postulating on the future of the cooperative effort between the U.S. and Russia. The conclusion includes an attempt to further surmise the efficacy of globalizing the framework that has been established between Russia and the United State in order to further prevent global nuclear proliferation.

**KEYWORDS:** Nuclear Proliferation, Nuclear Nonproliferation, United States and Russian Cooperation, Cooperative Threat Reduction Program, Strategic Arms Reduction, Nuclear Nonproliferation Regime, Nuclear Nonproliferation Treaty

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## THE INFLUENCE OF DEMOGRAPHY ON EUROPEAN AND FUTURE ARMED FORCES

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Such demographic factors in Europe as low fertility rates, high life expectancy, and the restricted immigration policy have caused European societies to age rapidly and the population of Europe will dramatically decline over the next thirty years. In comparison to Europe, the trend of aging in developing countries, for example in the Middle East and Northern Africa, presents a stark contrast. Taking into account demographic trends like aging, global distribution of the population and migration, Europe faces increasing geopolitical challenges in the future, based on the cleavages "north versus south," "rich versus poor," and "old versus young."

From a domestic point of view of continental Europe, the demographic factors are responsible not only for a declining workforce but also for increasing retirement rates. The consequences are a decreasing GDP and increasing social welfare costs. Further development of European armed forces in an uncertain world has to take place in this tense financial situation.

Taking the goals of the European Security Strategy into account and considering the necessity that the military capabilities have to be adapted to meet a new threat scenario, this thesis tries to illustrate why Europe has to intensify its efforts of European military integration, mindful of the limitation of demography and politics.

**KEYWORDS:** Demography, Demographic Development, Demographic Trends, Fertility, Mortality, Birth Rate, Migration, Dependency Ratio, Europe, Germany, Great Britain, France, Italy, Defense Budget, Social Budget, European Security and Defense Strategy, ESDS, NATO's Defense Capabilities Initiative, DCI, Gross Domestic Product, GDP

## SERBIA AND MONTENEGRO: TOGETHER FOREVER OR ONE-NIGHT STAND?

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Throughout the 1990s the republics of the former Yugoslavia fought a civil war resulting in the worst atrocities seen on European soil since World War II. The international community stood idly by while combatants in Slovenia and, especially, Croatia used techniques such as concentration camps, torture, rape and murder to attain their goals of "ethnically pure" societies. Despite intervening in the conflicts in Bosnia and Herzegovina from 1992-1995 and in Kosovo from 1998-1999, thousands suffered on an even greater scale than before. When the republic of Montenegro, still under the oppressive rule of Yugoslav President Slobodan Milošević, began making moves towards independence, again the international community decided to intercede. With significant arbitration led by the European Union, Serbia and Montenegro peacefully agreed to form a loose union and delay any efforts to create independent states. It is critical to understand why intervention worked in this case and not in the previous attempts with Bosnia and Herzegovina and Kosovo. Believing that international actors can affect state behavior without considering other factors can result in faulty policy decisions and failure to achieve the desired outcomes.

**KEYWORDS:** Serbia and Montenegro, Yugoslavia, Independence, Nationalism, Material Interests, European Union, ICTY

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## THE EUROPEAN UNION'S IMPACT ON TURKEY'S PATTERN CIVIL-MILITARY RELATIONS

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From the mid-1950s until 1997, civil-military relations in Turkey followed a distinct pattern. Friction between the armed forces and the civilian government led to a series of coup d'états, which then institutionalized greater political power for the military as the country transitioned back to a democracy. In essence, the seeds for subsequent interventions were planted by the previous coups. This happened in 1960, 1971 and 1980. This "friction, coup, power" pattern was sustained by the collective security environment during the Cold War. Turkey's "soft" coup of 1997 produced different domestic results because the international environment had changed. Even though Turkey was a democracy and a NATO member, it did not qualify for EU membership because of the quality of its democracy. One of the measures was its failure to gain civilian control over the military. Beginning in 1998, the EU tied the status of Turkey's civil-military relations to its membership bid. In July and August of 2003, the Turkish Parliament ratified a series of legislation packages designed to curb the influence of the military. These institutional changes designed by the European Union represent only the first step in Turkey's attempt to gain democratic civilian control of its military.

**KEYWORDS:** Civil-Military Relations, Turkey, European Union, Copenhagen Criteria, Helsinki Summit, Ozkok, Oostlander

## COURT OFFICERS AS CERTIFIED FIRST RESPONDERS ASSISTING IN HOMELAND SECURITY AND COMMUNITY EMERGENCY PREPAREDNESS

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This thesis tests the proposition that training New York State Court Officers to be first responders will add needed resources to the emergency response capabilities of the court system and state and local homeland security. New York State Court Officers have been exposed to a number of terrorist attacks, including the latest at the World Trade Center in September 2001. The *National Strategy for Homeland Security* notes that even the best-prepared states do not have adequate resources to respond to terrorist threats. The New York State Courts can add 3,700 new certified first responders if an event occurs in what is arguably the most likely target jurisdiction. The thesis shows that the added value of these officers on a state and local level would be extremely valuable. In light of this identified need for additional trained first responders, this thesis tests the proposition that training these officers to become certified first responders will enhance and improve the number of available resources to respond to terrorist incidents.

**KEYWORDS:** Court Officer, Certified First Responder, New York State Courts, Training, Law Enforcement

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## **POLITICAL CHANGE IN EUROPE AND THE FUTURE OF UNITED STATES MILITARY PRESENCE IN GERMANY**

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This thesis analyzes American basing structure in Germany, in a new political environment at the beginning of the 21<sup>st</sup> century. The end of the Cold War changed the political and strategic situation in Europe and the substance of American military presence in Europe. The War on Terrorism suggests that the current threats are dynamic and unpredictable and the idea of a permanent U.S. basing structure in the heart of Europe should be reconsidered. Specifically, this thesis describes the reasons for restructuring the large and expensive base structure in Germany and the impact of American withdrawal to the German society. Moreover, this thesis presents new challenges and opportunities for American military presence in other parts of the European continent. Finally, this thesis reviews the development of U.S. policy concerning present and future base structure in Europe.

**KEYWORDS:** Base Realignment and Closure Process, U.S. Base Structure in Germany, U.S. Military Presence in Europe



# MASTER OF ARTS IN SECURITY STUDIES

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## **THE ART OF PEACE: DISSUADING CHINA FROM DEVELOPING COUNTER SPACE WEAPONS**

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This thesis assesses the viability of applying dissuasion towards the development of offensive counter space (OCS) systems by China. As a relatively new defense policy and certainly one that has never been explicitly applied previously, this thesis delves into the characteristics prescribed by recent U.S. planning documents to develop a strategy that more appropriately addresses the current security concerns. Implicitly, dissuasion is intended to prevent future arms races with China through well-placed U.S. actions that channel adversary efforts in a direction desired by Washington.

Several things become clear during this investigation. First, very little scholarly work exists discussing the concept of dissuasion and the mechanisms used to formulate, implement and execute it as a defense policy. Second, that while an admirable attempt has been made to lessen the need for more costly policy options such as deterrence and defeat, dissuasion will not prevent China from developing counter space weapons, especially since ground-based jammers that target satellite links have already proven effective. Third, the best chance of dissuading China's efforts to acquire space-based OCS systems is through international treaties and laws.

**KEYWORDS:** Dissuasion, Deterrence, U.S. Defense Policies, National Security Strategy, NSS, Quadrennial Defense Review, QDR, National Defense Strategy, NDS, Space Superiority, Space Control, Counter Space, Offensive Counter Space, OCS, China, People's Liberation Army, PLA, PLA Modernization

## **AIRPOWER AND THE EMERGING U.S. SECURITY FRAMEWORK FOR THE PERSIAN GULF**

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The role of airpower in the Persian Gulf security framework is approaching an important crossroads as old missions end, strategic assumptions change and uncertain requirements emerge. Future requirements will be defined in a strategic environment where regional threats, relevant actors and U.S. interests have all evolved. For over a decade, airpower has contributed important capabilities to persistent missions to coerce and contain Iraq, but with these missions ending, new posture requirements must be defined. The effects based methodology framework presented here provides a useful system level model for thinking in terms of optimizing effects as strategy is operationalized.

Airpower will continue to support U.S. interests to preserve stable oil flows, diminish terrorism, promote regional stability and deter weapons of mass destruction proliferation from a new global posture construct emphasizing agile, expeditionary forces. Extremist sub-state actors, Iranian nuclear ambitions

and uncertain political, economic and social trends increasingly challenge these interests. The regional military strategy for U.S. Central Command focuses on three broad goals of warfighting, engagement and development. Airpower's precision, global reach and strike and network centric advances offer decision-makers useful capabilities to support these, making continued access to regional basing a strategic imperative.

**KEYWORDS:** Airpower, Persian Gulf, Strategy, Deterrence, Strategic Environment, Non-State Actors, Global War on Terrorism, Air Expeditionary Force, CONOPS, Global Posture Review, National Security Strategy

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