

Naval Postgraduate School  
Monterey, California 93943-5138



NPS-09-06-007

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# Compilation of Thesis Abstracts

June 2006



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



## PREFACE

This publication contains abstracts of unrestricted or unclassified theses submitted for the degrees doctor of philosophy, master of business administration, master of science, and master of arts for the June 2006 graduation. Classified and restricted distribution abstracts are listed on 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 World Wide Web edition of the School's catalog is at:  
<http://www.nps.edu/Admissions/QLinks/AcadCalendar.html>

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The *Compilation of Theses Abstracts* (unrestricted) can be found online at  
<http://www.nps.edu/Research/MoreThesisAbst.html>.

Summary of Research, an annual compilation of research projects and publications, is also available online,  
at <http://www.nps.edu/Research/SummaryRes.html>.



# 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:

To increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the United States of America 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.

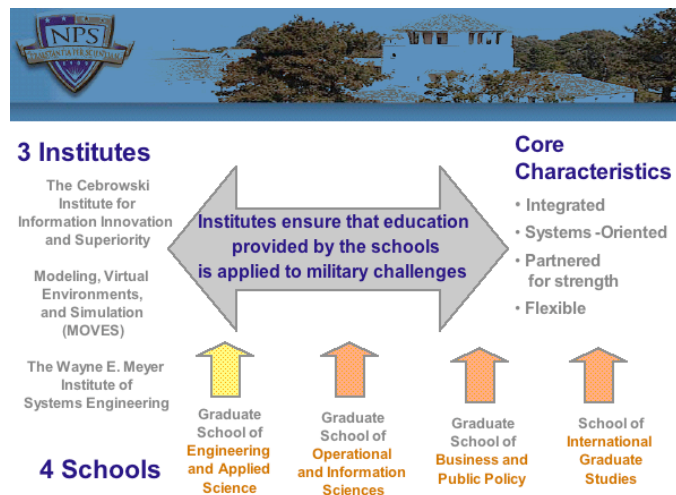
The research program at NPS exists to support the primary mission of graduate education. Research at NPS:

- 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
- Computer Technology
- Electronic Warfare Systems, International
- Human Systems Integration
- Information Sciences
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Joint C4I Systems
- Joint Information Operations
- Modeling, Virtual Environments, and Simulation
- Operations Analysis
- Operations Logistics
- Software Engineering
- Space Systems Operations
- Space Systems Operations, International
- Special Operations and Irregular Warfare

## **Graduate School of Engineering and Applied Sciences**

- Applied Mathematics
- Combat Systems Science and Technology
- Electrical Engineering
- Electronic Systems Engineering
- Engineering Acoustics
- Mechanical and Astronautical Engineering
- Meteorology
- Meteorology and Oceanography
- Oceanography
- Operational Oceanography
- Space Systems Engineering
- Systems Engineering
- Systems Engineering and Analysis
- Undersea Warfare
- Systems Engineering Management, Product Development
- Undersea Warfare, International

## **Graduate School of Business and Public Policy**

- Acquisition and Contract Management
- Defense Systems Analysis
- Defense Systems Management, International
- Executive Management
- Financial Management
- Information Systems Management
- Leadership Education and Development
- Logistics and Transportation Support Management
- Manpower Systems Analysis
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Transportation Management

## **School of International Graduate Studies**

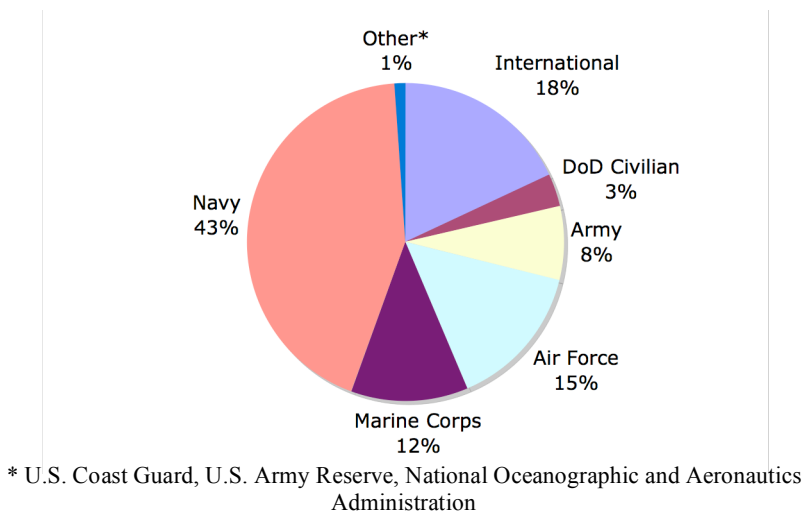
- Civil-Military Relations
- Defense Decision Making and Planning
- Homeland Security
- Security Studies: Stabilization and Reconstruction
- National Security and Intelligence:
- Europe/Russia/Central Asia
- Far East/Southeast Asia/Pacific
- Middle East/Africa/South Asia
- Western Hemisphere

## **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. The resident degree/subspecialty student population for June 2006 is shown in Figure 1 on the following page.

# INTRODUCTION

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**Figure 1: Resident Degrees/Subspecialty Student Population for June 2006  
(Total Enrollment: 1491)**

## Academic Degrees

Curricula are tailored to meet defense requirements within the framework of traditional academic degrees. All curricula lead to a master's, while additional study may yield an engineer's or doctoral degree. Below is a listing of the degrees offered at NPS:

### **Master of Arts Degrees**

National Security Affairs  
Security Studies

### **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  
Human Systems Integration  
Information Operations  
Information Systems and Operations  
Information Technology Management  
Leadership and Human Resource Development  
Management  
Mechanical Engineering  
Meteorology  
Meteorology and Physical Oceanography  
Modeling, Virtual Environments, and Simulation  
Operations Research  
Physical Oceanography  
Physics  
Product Development

Program Management  
Software Engineering  
Space Systems Operations  
Systems Engineering  
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 Science  
Mechanical Engineering  
Meteorology  
Modeling, Virtual Environments, and Simulation  
Operations Research  
Physical Oceanography  
Physics  
Software Engineering

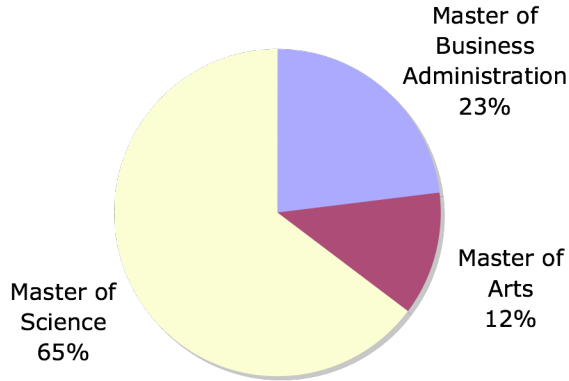
### **Doctor of Engineering**

Astronautical Engineering  
Engineering Acoustics  
Mechanical Engineering

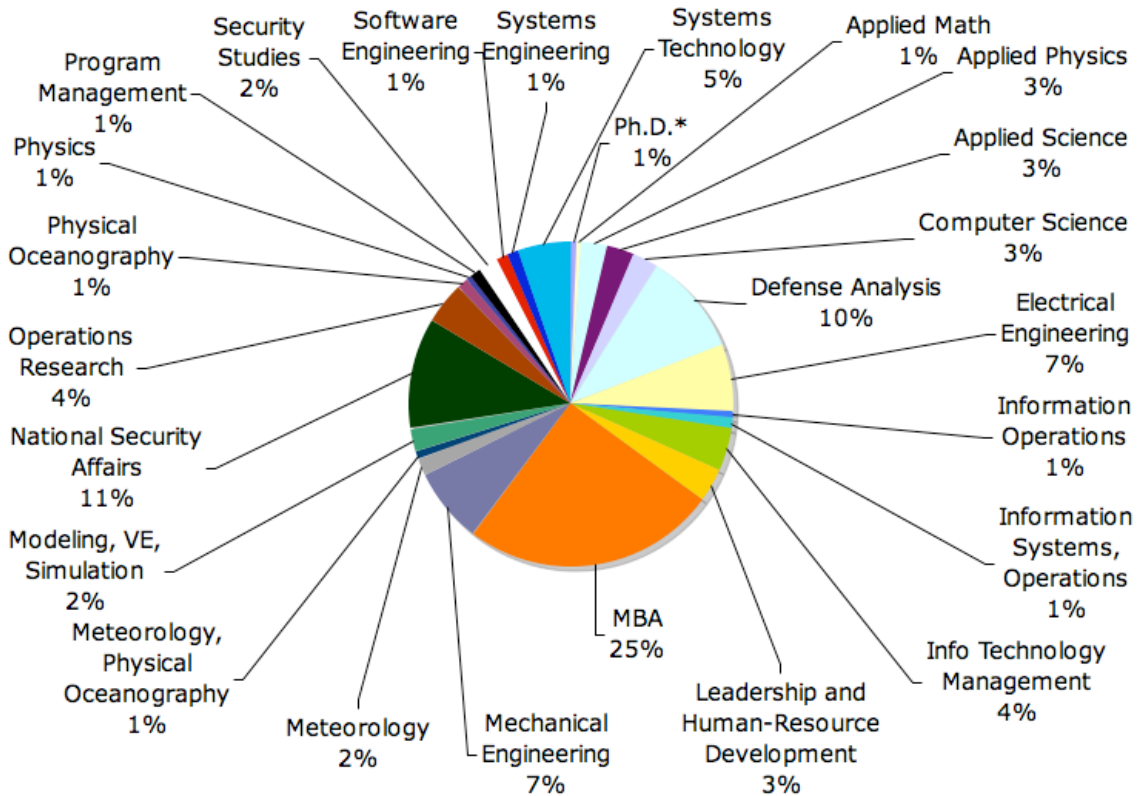
In June 2006, 231 degrees were conferred. Figure 2 indicates distribution by type, Figure 3 by degree area.

# INTRODUCTION

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



\*Advanced Degrees and Other: Ph.D. Software Engineering (1), Ph.D. Meteorology (1), MS Applied Mathematics (1), MS Information Operations (1), MS Operations Analysis (1), MS Space-Systems Operations (1)

**Figure 3. Degrees Conferred in June 2006  
(231 Degrees Conferred)**

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# INTRODUCTION

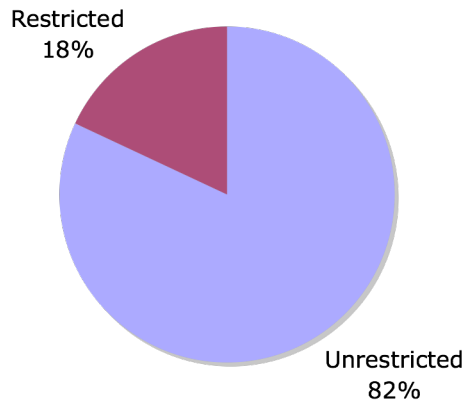
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## Theses

The thesis is the capstone of the student's academic endeavor at NPS. Thesis topics address issues ranging 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.

Aided by their faculty advisors, NPS students represent a vital resource within the DoD for addressing warfighting problems, one especially important at present, when technology in general, and information operations in particular, is changing rapidly. Our officers think innovatively and possess the knowledge and skill to apply nascent technologies in the commercial and military sectors. Their first-hand grasp of operations, when combined with a challenging thesis project that requires them to apply their focused graduate education, is one of the most effective elements in solving fleet/joint-force problems. NPS graduate education encourages a lifelong capacity for applying basic principles to the creative solution of complex problems.

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



**Figure 4. Classification of Theses**



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**ADVANCED DEGREES**

**Doctor of Philosophy**



# DOCTOR OF PHILOSOPHY

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## **AEROSOL OPTICAL DEPTH RETRIEVALS FROM HIGH-RESOLUTION COMMERCIAL SATELLITE IMAGERY OVER AREAS OF HIGH SURFACE REFLECTANCE**

**Dominick A. Vincent-Lieutenant Commander, United States Navy**

**B.S., Texas A&M University, 1994**

**M.S., Naval Postgraduate School, 2003**

**Doctor of Philosophy in Meteorology-June 2006**

**Advisor: Philip A. Durkee, Department of Meteorology**

The advancement and proliferation of high-resolution commercial imaging satellites presents a new opportunity for overland aerosol characterization. Current aerosol optical depth retrieval methods typically fail over areas with high surface reflectance, such as urban areas and deserts, since the upwelling radiance due to scattering by aerosols is small compared to the radiance resulting from surface reflection. The method proposed here exploits the difference between radiances from the adjacent shaded and unshaded areas of a scene. Shaded areas of the scene are primarily illuminated by diffuse irradiance that is scattered downward from the atmosphere, while unshaded areas are illuminated by both diffuse and direct solar irradiance. The first-order difference between the shaded and unshaded areas is the direct solar component. Given uniform surface reflectance for the shaded and unshaded areas, the difference in reflected radiance measured by a satellite sensor is related to the direct transmission of solar radiation and inversely proportional to total optical depth. Using an iterative approach, surface reflectance and mean aerosol reflectance can be partitioned to refine the retrieved total optical depth. Aerosol optical depth can then be determined from its contribution to the total atmospheric optical depth following correction for molecular Rayleigh scattering. Initial results based on QuickBird imagery and AERONET data collected during the United Arab Emirates Unified Aerosol Experiment (UAE2), as well as archive imagery and AERONET data for four other cities, indicate that aerosol optical depth retrievals are possible in the visible and near-infrared region with an uncertainty of  $\pm 0.04$  optical depth units for areas with surface reflectance values of 0.15, or 15%, and greater.

**KEYWORDS:** Aerosol, Satellite Observations, Aerosol Optical Depth Retrieval, Over Land, Shadow, High-Resolution Commercial Satellite Imagery, QuickBird, Desert, Urban, Grass, High Surface Reflectance



**MASTER  
OF  
BUSINESS ADMINISTRATION**



# **MASTER OF BUSINESS ADMINISTRATION**

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## **COMBAT COMPTROLLERS: CONSIDERATIONS ACROSS THE PLANNING CONTINUUM**

**John P. Anderson-Major, United States Army**

**Master of Business Administration-June 2006**

**Edward E. Marshall, Jr.-Captain, United States Air Force**

**Master of Business Administration-June 2006**

**Advisors: LtCol Randall B. Howard, USAF, Graduate School of Business and Public Policy**

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

In this MBA project, researchers examine the Air Force and Army Financial Management (FM) operations in the contingency environment. Transformational ways of comptroller operations are examined. This research also includes a brief history and lessons learned from World War II, current deployed FM operations in the Army and Air Force, and ways to obtain jointness through increases interoperability while reducing systems and training requirements.

**KEYWORDS:** Combat, Comptrollers, Financial Management, Contingency, Planning, Transformation, Interoperability, Financial Management History

## **A CASE ANALYSIS OF ENERGY SAVINGS PERFORMANCE CONTRACT PROJECTS AND PHOTOVOLTAIC ENERGY AT FORT BLISS, EL PASO, TEXAS**

**William J. Barich-Lieutenant, United States Navy**

**Master of Business Administration-June 2006**

**Brent L. Dassing-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2006**

**Antonio B. Harley-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2006**

**Advisors: Ron Tudor, Graduate School of Business and Public Policy**

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

The purpose of this MBA project is to review existing policy of the Federal Energy Management Program under the purview of the National Renewal Energy Laboratory (NREL) for energy-savings-performance contracts (ESPCs). This project assesses the ability of the Department of Defense to incorporate emerging technologies in alternative energy to supplement or replace existing power sources for DoD installations within the current ESPC policy. To do this, previous and existing ESPCs are reviewed. Further, a cost-benefit analysis of conventional power versus emerging photovoltaic energy for Fort Bliss in El Paso, Texas, is conducted. The project also includes an analysis of energy demands based on a new force alignment at Fort Bliss in accordance with recent base-realignment and closure (BRAC) findings. Current ESPC is reviewed and changes to allow for the use of emerging alternative energy technologies.

**KEYWORDS:** ESPC, Energy Savings Performance Contract, FEMP, Solar Power, Photovoltaic, PV, Fort Bliss, Power Grid, Cost Estimate

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## **BUSINESS PROCESS RE-ENGINEERING: APPLICATION FOR LITTORAL COMBAT SHIP MISSION MODULE ACQUISITION**

**Usher L. Barnum, Jr.-Commander, United States Navy**

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

**Second Reader: Mary Malina, Graduate School of Business and Public Policy**

The purpose of this MBA project is to investigate the possibility/feasibility of re-engineering the Littoral Combat Ship Mission Module (PMS-420) business process to function more efficiently. The defense-acquisition system is designed to support the National Security Strategy by managing the technologies and programs that produce weapons systems for the United States armed forces. Although the overall acquisition system functions well as designed, the purpose of this paper is to investigate the business process within PMS-420 and whether another design is more efficient. This paper reviews the genesis of Program Executive Office for Littoral and Mine Warfare (PEO-LMW) and its basic functionality, as well as discusses in detail the unique business process of PMS-420 and its varied inter-agency relationships. This paper discusses the efficient business processes of two other acquisition programs within PEO LMW: 1) Naval Special Warfare (PMS-340) and 2) Explosive Ordnance Disposal (PMS-408). While discussing these other acquisition programs, this paper notes the particular business processes and management policies that promote efficiency, and whether these attributes can be applied to PMS-420. The final portion of this paper is a summary of the findings and recommendations to PMS 420 in order for it to function more efficiently.

**KEYWORDS:** Acquisition, Business Process Re-Engineering, BPR, Littoral Combat Ship, LCS

## **CRISIS MANAGEMENT: OPERATIONAL LOGISTICS AND ASSET-VISIBILITY TECHNOLOGIES**

**Richard A. Braunbeck-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2006**

**Michael F. Mastria-Captain, United States Marine Corps**

**Master of Business Administration-June 2006**

**Advisors: Deborah E. Gibbons, Graduate School of Business and Public Policy**

**George W. Thomas, Graduate School of Business and Public Policy**

The purpose of this MBA project is to identify and explore logistical frameworks that leverage technology to overcome problems associated with coordinated logistics operations during crisis management. Over the past ten years, there have been significant advances in Radio Frequency Identification (RFID), satellite, and other related asset visibility technologies. These advances are mature enough to significantly increase the probability of achieving a useful Common Operational Picture during emergency response activities. Recent crisis response operations that would have benefited from improved asset visibility include the Indian Ocean tsunami, the Pakistani earthquake, Hurricane Katrina, and those related to the Global War on Terror. In each of these cases, multi-agency involvement, both foreign and domestic, compounded the complexity of asset tracking and communication protocols. The establishment of a logistics-tracking framework that provides adequate asset visibility, while maintaining operational security, will greatly increase the effectiveness of future crisis response operations. The proposed logistics framework serves as a viable solution for common logistical problems encountered by the U.S. and other industrialized nations while conducting crisis response operations. The framework identifies concepts, technologies, and protocols that can be used to improve crisis operations on a global scale.

**KEYWORDS:** Crisis Management, Asset Visibility, Radio Frequency Identification, Integrated Systems, Multi-Agency Coordination, Supply Chain Management, Satellite Communications, Logistics Operations, Relief Operations, Common Operational Picture

## **ACQUIRING COMBAT CAPABILITY THROUGH INNOVATIVE USES OF PUBLIC-PRIVATE PARTNERSHIPS**

**Steven M. Buchanan-Captain, United States Air Force**

**Master of Business Administration-June 2006**

**Jayson W. Cabell-Captain, United States Air Force**

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**Master of Business Administration-June 2006**

**Daniel C. McCrary-Captain, United States Air Force**

**Master of Business Administration-June 2006**

**Advisors: Joseph G. San Miguel, Graduate School of Business and Public Policy**

**John K. Shank, Graduate School of Business and Public Policy**

**Donald E. Summers, Graduate School of Business and Public Policy**

In this thesis, researchers study the federal government's historical use of public-private partnerships (PPPs) and the changing view by the government on using PPPs to overcome resource constraints. Researchers study recent applications (case studies) of innovative financing arrangements by Hannon Armstrong, LLC, an Annapolis, Maryland, based financial services firm. Hannon Armstrong's "fee for service contract" solution to the lack of appropriated capital funds needed for a vital fiber-optic link near the Arctic Circle serves as the basis for applying third party financing to overcome appropriated fund constraints. Specifically, the history of the energy-saving performance contracts (ESPCs), which have been a useful tool in reducing the energy consumption throughout the federal government, is explored. This program has historically only been used for fixed assets; however, it is believed that applying ESPCs to mobile assets could help reduce the energy consumption of the Department of Defense and save taxpayers millions of dollars, while increasing the combat capabilities of existing weapons platforms.

**KEYWORDS:** Public Private Partnership, Energy Savings Performance Contract, Third Party Financing, Alternative Financing, Fee for Service Contract

## **UTILIZING INFORMATION TECHNOLOGY TO FACILITATE RAPID ACQUISITION**

**Joshua R. Burris-Major, United States Army**

**Master of Business Administration-June 2006**

**Advisor: Ron Tudor, Graduate School of Business and Public Policy**

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

This thesis explores how innovative information technologies can facilitate rapid acquisition by using new online information technologies. In the past decade, many legislative and executive branch initiatives have paved the way for government disengagement and commercial engagement within the acquisition community. With new technology and the exponential amount of information now being infused electronically around the world, it is imperative that we take advantage of the tools that the government and private commercial industry have to offer. The vision, within the acquisition community, is for online ordering systems to facilitate streamlined commercial item acquisitions that reap the benefits of improved efficiency, reduced overall costs, and timeliness. This thesis focuses on new technology, the issues surrounding current processes, and the future of rapid online acquisition.

**KEYWORDS:** Rapid Acquisition, eCommerce, eProcurement, Information Technology, Contracting, Global Information Network Architecture, Global Information Grid, Future of eProcurement

## **COMPARISON OF THE NAVY WORKING-CAPITAL FUND AND MISSION FUNDING AS APPLIED TO NAVY SHIPYARDS**

**Andrew M. Cain-Lieutenant, United States Navy**

**Master of Business Administration-June 2006**

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

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

The dramatic political and economic events, both globally and within the United States, during the early 1990s led to significant changes to the Navy shipyard organizational structure. As part of the Navy maintenance regionalization and consolidation program, the financial management system used to manage these commands has changed. Specifically, the Navy has shifted two of its four shipyards, with authorization to shift the other two in fiscal year 2007, from the Navy Working Capital Fund to mission funding through direct congressional appropriations.

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This funding shift has raised questions about the advantages and disadvantages each financial system provides shipyards, the operating differences that occur due to the funding change, and the future financial consequences of funding Navy shipyards using direct appropriations.

This thesis identifies the advantages and disadvantages of the Navy Working Capital Fund and the mission-funding model in the context of a Navy shipyard environment, and determines whether the change in financial structure provides an overall benefit that should be pursued for all shipyards.

**KEYWORDS:** Navy Working Capital Fund, Mission Funding, Direct Appropriations, Depot Maintenance, Intermediate Maintenance, Navy Shipyards

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## ANALYSIS OF DESIGN-BUILD PROCESSES, BEST PRACTICES, AND APPLICATIONS TO THE DEPARTMENT OF DEFENSE

**Kim S. Cantrell-DoD Civilian**

**Master of Business Administration-June 2006**

**Advisor: Rene G. Rendon, Graduate School of Business and Public Policy**

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

The Federal government's preference for the acquisition of commercial items was placed into law under Public Law 103-355, Federal Acquisition Streamlining Act of 1994. Acquisition policies were established that more closely resembled those of the commercial marketplace and the law encouraged the acquisition of commercial supplies and services. This law did not extend to the acquisition of design-build construction. Acquisition policy regarding government design-build should be analyzed to determine which best commercial processes/practices may be applied to the acquisition of government design-build.

Design-build (DB) is defined as a project-delivery system in which the owner contracts with, and holds responsible, one single entity for both design and construction of a project. This method differs from the traditional design-bid-build (DBB) approach in which the owner contracts with an architect to design the project (prepare drawings and specifications) under a design contract and then competitively bids the project among construction contractors to build the facility.

With Naval Facilities Engineering Command's (NAVFAC) mandate that by the end of fiscal year (FY) 07, 75% of capital improvement projects above \$750,000 will be accomplished by design-build acquisition, it is imperative that we look into utilizing non-Department of Defense design-build processes/practices to allow flexibility, creativity, and innovation in design approach; take advantage of time-savings; and complete projects within cost. In order to achieve this goal, NAVFAC strategy is to ensure that the most efficient business processes are in place.

The purpose of this research is to examine current non-DoD design build processes, determine best practices, analyze the application of these best practices to the award and administration of DoD (specifically NAVFAC) design-build contracts, and provide recommendations.

**KEYWORDS:** Design-Build, Design-Bid-Build, DBIA, Commercial Best Practice, Acquisition Planning, Naval Facilities Engineering Command, Solicitation Planning, Solicitation, Source Selection, Contract Administration, Contract Closeout, Contract Management Maturity Model, CMMM

## ANALYSIS AND FORECASTING OF OPERATING AND SUPPORT COSTS FOR F-16 C/D

**Aurel Cobianu-Major, Romanian Air Force**

**Master of Business Administration-June 2006**

**Konrad Madej-Captain, Polish Air Force**

**Master of Business Administration-June 2006**

**Advisors: Raymond E. Franck, Graduate School of Business and Public Policy**

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

In this MBA project, researchers examine and present an extended overview of total lifecycle system management (TLCSM) from the standpoint of U.S. Air Force and other Department of Defense organizations, and make available a guide for implementing this concept. The report infers that TLCSM should be the foundation for effective management of complex weapon systems such as a multi-role fighter aircraft. The primary objective is to understand the methodological specifics of estimating operating and support (O&S) costs for the F-16 fighter aircraft. To facilitate this, the report identifies and analyzes the top cost drivers over the F-16C/D lifecycle. The cost drivers are a major consideration in identifying reduction-of-total-ownership-costs (R-TOC) opportunities. This research also explores forecasting techniques to estimate the cost per flying hour (CPFH). Holt's method appears to have promise as an estimator of future CPFHs. Finally, this report concludes that TOC should be a priority consideration when acquiring a multi-role fighter aircraft such as F-16, and recommends that the Polish Air Force (recent F-16 user) and the Romanian Air Force (potential user) should establish databases to record O&S costs and should implement R-TOC best practices.

**KEYWORDS:** Total Lifecycle System Management, TLCSM, Operating and Support Costs, O&S Costs, Reduction of Total Ownership Costs, R-TOC, Cost per Flying Hour, CPFH

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## DEVELOPMENT OF A BUSINESS-CASE ANALYSIS FOR THE ACQUISITION OF THE AGILE, RAPID, GLOBAL, COMBAT-SUPPORT (ARGCS) SYSTEM

**David J. Crosby-Commander, United States Navy**

**Master of Business Administration-June 2006**

**Advisors: William Gates, Graduate School of Business and Public Policy**

**Daniel Nussbaum, Department of Operations Research**

A business-case model is developed to examine the economic potential of the agile, rapid, global combat-support (ARGCS) system. The model is prepared to provide a critical view of ARGCS and to determine if the advanced concept-technology demonstration (ACTD) showed a value returned for the expenditure of funds. This project identifies and outlines the appropriate method, and prepares the model for developing a business case for incorporating the ARGCS system into maintaining joint defense equipment.

This project, conducted with the sponsorship and assistance of the Office of the Secretary of Defense, examines how integrating ARGCS would provide benefit to naval aviation as an augmentation to the consolidated automated-support systems (CASS) currently used in aviation maintenance. A methodology is developed to prepare a business-case analysis to be used on actual cost data and for future business-case analyses.

**KEYWORDS:** Advanced Concept Technology Demonstration, Agile Rapid Global Combat Support, Business Case Analysis, Enhanced Consolidated Automated Support System

## EVALUATING THIN-CLIENT COMPUTERS FOR USE BY THE POLISH ARMY

**Krzysztof K. Felisiak-Captain, Polish Army**

**Master of Business Administration-June 2006**

**Pawel S. Grunt-Lieutenant, Polish Army**

**Master of Business Administration-June 2006**

**Advisors: Douglas E. Brinkley, Graduate School of Business and Public Policy**

**Raymond E. Franck, Graduate School of Business and Public Policy**

The purpose of this MBA project is to examine the technical capabilities of thin-client devices to determine if they could successfully replace traditional personal computers (PCs) within a Polish army command environment. In order to accomplish this, authors build a prototype thin-client network and test the compatibility of the system using software applications used by the Polish army. The project also analyzes the costs of implementing and operating a thin client-based network compared to a traditional PC network. In addition, the project investigates the feasibility of exporting thin-client technology to Poland and determines any trade restrictions involved. Finally, the project presents conclusions and recommendations drawn from theory and practical experiments.

**KEYWORDS:** Thin Client, Thin Client Computing, Terminal Servers

## IMPROVING THE NAVY'S OFFICER BONUS PROGRAM EFFECTIVENESS

**William N. Filip-Lieutenant, United States Navy**

**Master of Business Administration-June 2006**

**Advisors: William Gates, Graduate School of Business and Public Policy**

**Peter Coughlan, Graduate School of Business and Public Policy**

**William Hatch, Graduate School of Business and Public Policy**

Bonuses serve as a valuable tool in attracting and retaining Naval officers. This thesis analyzes the way officer bonuses are currently distributed in the Navy and provides recommended changes based on analysis of scholarly publications. Combining the information gained from current policies and research already conducted in the academic arena, the author proposes a workable bonus structure to meet the recruitment and retention goals while providing the Navy flexibility, quality personnel, and cost effectiveness. Combining auction theory and signaling theory into a new program has great potential to provide flexibility to the Navy, maintain the appropriate quantity and quality of officers, and provide cost savings to the Navy, while providing continued service member satisfaction. By offering bonus programs of different rates and time commitments, effectiveness and personnel quality can be increased by allowing officers to signal their

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intentions to the Navy. Auctions can be used to determine the appropriate monetary values to offer under each contract. By implementing an auction for bonus amounts, the Navy helps to ensure that bonuses will be competitive with the overall job market. This approach provides the Navy with a flexible, effective officer bonus program that is responsive to existing job market conditions.

**KEYWORDS:** Military Compensation, Bonuses, Auctions, Auction Theory, Signaling, Signaling Theory, Incentives, Job Market, Force Reduction, Retention

### **LEARNING FROM EACH OTHER: COMPARATIVE ANALYSIS OF THE ACQUISITION PROCESS OF LITHUANIA AND THE UNITED STATES**

**Nicola M. Gathright-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2006**

**Rima Ambrazeviciene-Republic of Lithuania Ministry of National Defense**

**Master of Business Administration-June 2006**

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

**Ron Tudor, Graduate School of Business and Public Policy**

The purpose of this project is to provide a macro-level comparison of the acquisition systems supporting the defense systems of Lithuania and the United States. Due to the broad scope of this project, research is focused primarily on the similarities and differences of the two acquisition systems, as well as their strengths and weaknesses. Suggestions are presented for improving or strengthening each system.

**KEYWORDS:** Acquisition Process, Procurement, Contracting, Defense Acquisition

### **A CASE STUDY OF THE UNITED STATES NAVY'S ENTERPRISE RESOURCE PLANNING SYSTEM**

**William Jackson-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2006**

**Harold Carver-Lieutenant, United States Navy**

**Master of Business Administration-June 2006**

**Advisor: Glenn R. Cook, Department of Information Sciences**

**Second Reader: Douglas E. Brinkley, Graduate School of Business and Public Policy**

A case analysis of the Navy's Enterprise Resource Planning (ERP) efforts is conducted, from the decision to adopt ERP up to the current Navy ERP program. The objective is to develop a single-source document that provides the reader with enough information to have an understanding of the ERP efforts within the Navy. This study analyzes the history of ERP systems and the lessons learned from the commercial sector. The revolution in business affairs motivated the Navy to adopt ERP systems in 1997 and an initial program consisting of four pilots was initiated at major shore commands. Although the Navy viewed the pilots as a success, Congress criticized the pilots as a waste of one billion dollars. The Navy is continuing with the project and will integrate them into the current Navy ERP (N-ERP) program. N-ERP was established in 2004 and is expected to be complete in 2011 at a cost of over 800 million dollars.

**KEYWORDS:** ERP, Enterprise Resource Planning, Revolution in Business Affairs

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### **FINANCING THE DEPARTMENT OF DEFENSE'S ACQUISITION BUDGET: INNOVATIVE USES OF PUBLIC-PRIVATE PARTNERSHIPS**

**Patrick Jankowski-Lieutenant Commander, United States Navy**

**Master of Business Administration-June 2006**

**Matthew Lehmann-Lieutenant, United States Navy**

**Master of Business Administration-June 2006**

**Michael McGee-Lieutenant, United States Navy**

**Master of Business Administration-June 2006**

**Advisors: Joseph G. San Miguel, Graduate School of Business and Public Policy**

**Donald E. Summers, Graduate School of Business and Public Policy**

This project identifies a need for alternative financing options in the Department of Defense to provide increased capability to the warfighter in today's exigent military environment. Further, this project compares the history of public-private partnerships in the U.S. government with the United Kingdom Ministry of Defense (MOD). Researchers showcase the increased capabilities currently enjoyed by the UK MOD from entering into these agreements. Additionally, an in-depth look at three private-finance initiatives (PFIs) undertaken by Serco, Inc., is provided, including future prospects for the private-financing technique. Finally, this analysis evaluates the value for money gained by using public-private partnerships through proper risk transfer in lieu of full up-front funding. The examination concludes that continued and expanded use of public-private partnerships provides increased real time capability to DoD while supporting private industry. Public-private-partnership agreements may not always be the most inexpensive means of procurement from a purely financial standpoint. However, this relationship provides several tangible real-time benefits to the government and seeks to reduce the full lifecycle cost.

**KEYWORDS:** Private Finance Initiatives, Public Private Partnerships, DoD Finance Initiatives

### **APPLICATION OF THE COMPLEXITY MANAGEMENT BUSINESS APPROACH IN THE DEPARTMENT OF DEFENSE'S FINANCIAL FUNCTIONS**

**Jorge I. Jimenez-Captain, United States Air Force**

**Master of Business Administration-June 2006**

**Advisors: Uday M. Apte, Graduate School of Business and Public Policy**

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

This project describes the emerging approach of complexity management, translates it for use in the Department of Defense, and applies its principles to DoD's financial functions. Complexity management is a new business approach introduced by the George Group Consulting company. The basic principle behind this approach is the identification and manipulation of complexity to improve efficiencies and reduce cost in an organization. The ultimate goals of this project are to:

- Analyze the complexity management approach, as presented by the George Group.
- Evaluate the feasibility of applying the approach in the DoD, in particular to its financial functions.
- Determine if this new business approach would be useful in DoD.

Most people would agree that DoD is an extremely complex organization due to its size, mission, and nature. As such, complexity management should be an imperative approach in its operations and a fundamental part of its culture. This project provides an introduction to complexity management and a discussion of the benefits DoD could achieve with this new business approach.

**KEYWORDS:** Complexity Management, Operations Management, DoD Financial Systems, GFEBS, ERP, DEAMS

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## TRANSFORMATIONAL BUDGET CONSIDERATIONS IN PURSUIT OF THE TOTAL-FLEET CONCEPT

**Jeffrey L. Kirby-Commander, United States Navy  
Master of Business Administration-June 2006**

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

The “total-fleet” concept calls for a maritime force for the nation that essentially combines the assets and unique capabilities of each maritime agency available to the U.S. government and forms a scalable force that can be employed around the globe to accomplish missions in the national interest. The U.S. Navy is the preeminent maritime power in the world. In light of the emerging asymmetrical threat from non-peer competitor forces, the Navy has embarked on a stated program of building up its littoral and low-level regional capability in order to engage these adversaries in their own environment. This thesis studies the Navy’s budget requests of the Future-Years Defense Program, and examines whether these budget requests and the long-range 30-year shipbuilding plan are leading to the transformational fleet that is envisioned by the total-fleet concept, or are a continuation of the predominantly blue-water, operations-focused fleet and the assets that accompany that strategy.

**KEYWORDS:** Total Fleet Concept, Budget Requests, Shipbuilding Plan, Littoral Combat Ship, DD(X), Joint High Speed Vessel, Transformation, Coast Guard, Integrated Deepwater System, Army Watercraft, Customs and Border Patrol, Future Years Defense Program, FYDP, Quadrennial Defense Review, QDR

## RESTRUCTURING THE MILITARY RETIREMENT SYSTEM FOR COST SAVINGS AND INCREASED OFFICER SATISFACTION

**William R. Lance-Lieutenant, United States Navy  
Master of Business Administration-June 2006**

**Advisors: Aruna Apte, Graduate School of Business and Public Policy  
Nayantara Hensel, Graduate School of Business and Public Policy**

The purpose of this MBA project is to investigate the current military-retirement system and provide insight into its effect on active duty officers’ job-satisfaction levels. The goal of this project is to identify and document both the current military-retirement system and a theoretical matched thrift-savings-plan (TSP) option. The primary tools used to accomplish this goal are theoretical net present value (NPV) analysis of several different retirement options, and a survey of military students conducted on the Naval Postgraduate School campus to gauge their reaction to a hypothetical military-retirement plan that more closely resembles those found in the civilian sector.

**KEYWORDS:** Military Retirement, Retirement Plans, Thrift Savings Plan, TSP, Matching Contributions, Compensation

## REQUIREMENT ANALYSIS: EVALUATING THE DEGREE OF HETEROGENEITY FOR DETERMINING AN APPROPRIATE BASIS FOR CONTRACT AWARD

**Chia-Jung Lee-Lieutenant Colonel, Republic of China (Taiwan) Air Force  
Master of Business Administration-June 2006**

**Advisor: Rene G. Rendon, Graduate School of Business and Public Policy  
Second Reader: Marshall R. Engelbeck, Graduate School of Business and Public Policy**

The Ministry of National Defense (MND) of the Republic of China (Taiwan) commonly uses the lowest-tender and the most-advantageous-tender approach in contract award procedures. Depending on the degree of heterogeneity of the requirement, either the lowest-tender or the most-advantageous-tender approach could be used. However, there is no procedure to determine how to evaluate the degree of heterogeneity of the requirement. This MBA project researches how to evaluate the degree of heterogeneity to determine the most appropriate basis for contract award. The research identifies the criteria used to evaluate the degree of heterogeneity of the requirements. The result of this research is a developed model for the contracting officer (CO) or program officer (PO) to use in evaluating the heterogeneous degree of requirement. Then, based on the result of the model, the PO and CO will know which is an appropriate basis for contract

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award. This research supports the Taiwan Ministry of National Defense CO and PO in deciding on a requirement strategy to produce a well designed procurement program and to get a best-value product.

**KEYWORDS:** Heterogeneity, LPTA, Best-Value, The Lowest Tender, The Most Advantageous Tender, Taiwan, MND, Government Procurement Act

### A COMPARATIVE ANALYSIS OF THE DEPARTMENT OF DEFENSE'S PASSIVE RADIO-FREQUENCY IDENTIFICATION POLICY AND PERSPECTIVE IN TERMS OF SITE IMPLEMENTATIONS

**Jacqueline M. Meyer-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2006**

**Sefa Demirel-Lieutenant Junior Grade, Turkish Navy  
Master of Business Administration-June 2006**

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

The purpose of this MBA project is to conduct a comparative analysis of the Department of Defense's policy and perspective on passive radio-frequency identification (RFID) in terms of site implementations at the Fleet and Industrial Supply Center (FISC), Norfolk, Virginia, Ocean Terminal Division (OTD), and the Defense Distribution Depot San Joaquin (DDJC), California. The Norfolk OTD container-freight station has been at the forefront of DoD activities implementing passive RFID and is currently using RFID tags to process all shipments except household goods. DDJC is equipped with RFID readers and the required supporting infrastructure, and has been accepting pallets and cases with passive RFID tags since January 2005. The DoD is in the midst of a fundamental transformation of its logistics capabilities, and RFID is becoming an integral element of that transformation with the potential to revolutionize the entire supply chain. On July 30, 2004, the Acting Under Secretary of Defense for Acquisition, Technology, and Logistics issued a memorandum delineating the final policy and an extensive plan for RFID implementation within the DoD. This project explains the DoD's passive RFID policy and perspective and provides observations from the site implementations. The project presents the cause(s) of compliance variances between the projected plan based on DoD policy and the actual implementations at DoD activities.

**KEYWORDS:** Radio Frequency Identification, RFID, Emerging Technology, Technology Implementation, DoD RFID Mandate, Implementation Plan, In-Transit Visibility, Total Asset Visibility

### THE EVOLUTION OF THE DEFENSE BUDGET PROCESS IN UKRAINE, 1991-2006

**Roman Mileshko-Major, Ukrainian Navy  
Master of Business Administration-June 2006**

**Advisor: Richard Doyle, Graduate School of Business and Public Policy  
Second Reader: Frank Barrett, Graduate School of Business and Public Policy**

This thesis describes the evolution of the defense budget process in Ukraine, from independence to 2006. It identifies and evaluates factors that directly affected the development of the defense budget process and determined the distribution of power in that process, and examines the efficiency of defense budgets as policy tools. This study contributes towards an understanding of the relative power of the executive versus the legislative branch in shaping defense policy. It concludes that important but limited progress has occurred in the defense budget realm in Ukraine since independence. The absence of clear political guidance, deficiencies of defense legislation, and insufficient levels of co-operation between the executive and the legislative branch of the government are key problems involved in defense budgeting and reform in Ukraine. Certain improvements and overall intensification of efforts occurred as a result of the NATO-Ukraine Action Plan in 2002. Actions undertaken by the Ukrainian government during the period from 2002 to the beginning of 2006, including the introduction of the Law on Organization of the Defense Planning in 2004, had minimal impact because of insufficient interest at the legislative level.

**KEYWORDS:** Ukraine, Defense, Budget, Defense Reform, Verkhovna Rada, NATO

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## MEASURING THE VALUE OF GRADUATE MANPOWER-SYSTEMS ANALYSIS EDUCATION FOR NAVAL OFFICERS

**Lindsay M. O’Sullivan-Lieutenant, United States Navy  
Master of Business Administration-June 2006**

**Advisors: Stephen L. Mehay, Graduate School of Business and Public Policy  
Alice M. Crawford, Graduate School of Business and Public Policy**

This thesis examines methods to assess the value of the manpower-systems analysis (MSA) curriculum at the Naval Postgraduate School. What exactly does the Navy get from the MSA curriculum graduates? Is the return on investment simply an increase in “quality of life,” thus increasing retention? Or does the MSA curriculum teach graduates the necessary skills for follow-on billets? Individuals in the private and public sectors have tried to quantify the value of both training and education. However, currently most measures of effectiveness are based purely on financial aspects of the education. Little has been done to capture the result of the investments in human capital on any part of the organization. The result of this research is the creation of two surveys that will be used as vehicles to assess the value of the MSA curriculum to the Navy and to the graduate. The surveys created are for MSA graduates and their immediate supervisors. This research identifies specific measures and survey techniques that can be used to evaluate education and training. In the future, this approach can be applied to other curricula.

**KEYWORDS:** Manpower/Supply, Human Capital, Utilization, Manpower Policy Issues, Training, Education, Requirements/Determination, Leadership, Retention, Human Resources, Graduate

## NATURAL DISASTER: A MILITARY OPTION FOR INCREASED RESPONSIVENESS

**Homero Ramos-Lieutenant, United States Navy  
Master of Business Administration-June 2006**

**Michael Pereira-Lieutenant, United States Navy  
Master of Business Administration-June 2006**

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

The purpose of this MBA project is to study the feasibility of a military fast reaction team that would provide emergency services in a “declared” domestic national disaster. It is believed that initial responses might be coordinated and implemented more effectively by a specially trained military team. The response time-period being considered would be immediately preceding a forthcoming “declared” disaster, during the actual disaster, and immediately following the disaster for a short period of time until longer term assistance can be established. After a disaster has been declared either at the federal, state or local level, a military fast reaction team consisting of specialized military personnel could descend upon the affected area to undertake life critical issues.

**KEYWORDS:** Natural Disaster, Military Option, Military Disaster Response

## MILITARY HEALTHCARE SYSTEM AND TRICARE: AN ECONOMIC ANALYSIS INDICATES THE OCCURRENCE OF SELF-SELECTION

**John W. Ryan-Lieutenant, United States Navy  
Master of Business Administration-June 2006**

**Chris M. Wise-Lieutenant Commander, United States Navy  
Master of Business Administration-June 2006**

**Advisors: David R. Henderson, Graduate School of Business and Public Policy  
Jerry L. McCaffery, Graduate School of Business and Public Policy**

In this project, researchers attempt to demonstrate that by increasing cost shares to beneficiaries associated with the Tricare program, greater efficiency and cost savings in the military healthcare system could be achieved. While unable to prove this, evidence is found of self-selection occurring among Tricare Standard enrollees. Enrollees in Tricare Standard are consuming care at a much higher rate than Tricare Prime enrollees. Standard enrollees are making a decision to pay for care so they can have a choice in where that care is received. Studies show that there are some common characteristics of people who will forgo

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cheaper, more restrictive plans and maintain more flexible, higher cost plans. Factors causing people to pay for care instead of taking free military care include having a higher income, having a previous history of high medical care usage, and having an attraction to the perceived better services offered by civilian doctors. Analysis of this self-selection could have implications for future policy decisions concerning the military healthcare system.

**KEYWORDS:** Healthcare, Military Healthcare, Tricare, Self Selection, CHAMPUS

### **ANALYSIS OF LOGISTICS DIFFERENCES WITHIN THE EUROPEAN UNION, WITH RECOMMENDATIONS FOR TURKEY AS A CANDIDATE**

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**Master of Business Administration-June 2006**

**Mehmet Turk-First Lieutenant, Turkish Army**

**Master of Business Administration-June 2006**

**Advisors: Geraldo Ferrer, Graduate School of Business and Public Policy**

**Uday M. Apte, Graduate School of Business and Public Policy**

In this thesis, researchers present consequences of joining the European Union from the logistics point of view. The European Union (EU) has become a huge entity, which includes members having great differences in many fields. Despite many regulations that have been applied to standardize the systems of those countries, there are still areas with diverse applications. One of the fields in which significant differences are observed is the area of logistics. The purpose of this study is to provide a guide for EU candidates that demonstrates ways to improve and unify their logistics systems in accordance with EU requirements. The study presents the analysis of logistics disparities in different regions of the EU and how EU policies and regulations are trying to avoid their negative effects. Finally, Turkey is analyzed as a model for other candidate countries. After studying the effects of different logistics applications within the Union, they can judge themselves in comparison with Turkey.

**KEYWORDS:** European Union, Turkey, Logistics, Regional Differences, Intermodal Transportation, Regulations and Policy, Candidates

### **BUSINESS PROCESS REENGINEERING IN THE INVENTORY MANAGEMENT TO IMPROVE AIRCRAFT-MAINTENANCE OPERATIONS IN THE INDONESIAN AIR FORCE**

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**Master of Business Administration-June 2006**

**Advisor: Glenn R. Cook, Department of Information Sciences**

**Second Reader: Uday M. Apte, Graduate School of Business and Public Policy**

The Indonesian air force has utilized computers in its administration as early as 1990. The computers, however, have not yet been optimized to support inventory management in aircraft maintenance operations, especially for the helicopter fleet. The processes for materials procurement to support the maintenance operations still rely heavily on the services of intermediaries. even though the air force has already adopted the automatic logistic management system (ALMS), there are several weaknesses in supporting the material procurement processes.

The objective of this study is to propose the implementation of the material requirement planning (MRP) method to improve inventory management in the Air Force's helicopter fleet. It is hoped that by implementing the MRP, the air force can get the right materials in the right amount at the right time without imposing unnecessary costs by minimizing the roles of the intermediaries.

The implementation of MRP, however, cannot be done without redesigning the business process in material acquisition and transforming it to an IT-enabled business process. Therefore, this study also discusses the business-process reengineering (BPR) concept in order to support the implementation of the MRP.

**KEYWORDS:** Inventory Management, Business Process Reengineering, Business Transformation, Material Requirement Planning, Information Technology, Supply Chain

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# MASTER OF BUSINESS ADMINISTRATION

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## ESSENTIAL ELEMENTS IN INTERNATIONAL CONTRACT NEGOTIATIONS

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**Master of Business Administration-June 2006**

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**Second Reader: Roxanne V. Zolin, Graduate School of Business and Public Policy**

This research examines the interaction of groups in the environment of international contract negotiations. The thesis addresses psychological aspects of negotiation, such as roles of social relationships, egocentrism, motivated illusions, and emotion. The thesis examines the role of culture in cross-border negotiations and describes major effects from negotiation definitions, selection of negotiators, protocol, communication, time, risk propensity, group versus individual decision making, and nature of the agreement. Interviews conducted with expert negotiators yield a set of factors that research participants identify as the most influential in the negotiation process and its outcome. Recommendations are offered in regards to common issues that arise during an international negotiation process. These include a) thoroughly preparing for all aspects of the contract, b) aiming toward mutual gain, c) planning for alternatives that the other party can accept, d) expressing disagreements in a polite and non-argumentative manner, e) adjustment to the degree of formality of the host team, and f) understanding the other party's authority to commit, as well as the decision making structure of the organization it represents. If a negotiator learns to cope with them at a sufficient level, then he/she has enough tools in his/her possession for the purpose of negotiation.

**KEYWORDS:** Negotiations, International Contract Negotiations, Culture and International Negotiations

## IMET FEASIBILITY STUDY AND IMPLEMENTATION: MAXIMIZING THE GRADUATE SCHOOL OF BUSINESS AND PUBLIC POLICY EXPERIENCE FOR INTERNATIONAL STUDENTS AT THE NAVAL POSTGRADUATE SCHOOL

**Theodoros Tsamoglou-Major, Hellenic Air Force**

**Master of Business Administration-June 2006**

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

The purpose of this MBA project is to assess prior proposals relevant to various problems that NPS's Graduate School of Business and Public Policy (GSBPP) international-military students experience and how those problems could be alleviated, and to identify new needs and problems they face while at the Naval Postgraduate School in the areas of academic support and quality of life. The goal of this study is to determine the feasibility of the above recommendations, present ways for implementation of all feasible recommendations, and report on their implementation. The research includes the conduct of a survey among current international students at GSBPP. The proceedings of this initiative and pertinent issues for both developing an implementation strategy and facilitating the gathering of critical information international students need in order to achieve a more comprehensive understanding are analyzed and discussed. Some issues explored include opportunities for streamlining academic support, such as more computer facilities in the library, more access to home-country resources for news and research, opportunities for improving the quality of life (such as the non-saluting issue, parking, accommodations, and more trips with international families), and finally, the possibility of establishing a new faculty briefing/workshop with the intent of helping new instructors understand the distinct status of international students, and toward achieving better communication with them at GSBPP. Various implications of this study are considered and subjects for future research are identified. Lessons and methodologies that can be extrapolated from this study are identified and recommendations are proposed to ensure maximization of the learning experience of the international students at GSBPP or NPS as a whole.

**KEYWORDS:** International Military Student, Graduate School of Business and Public Policy, Academic Issues, Academic Support Issues, Quality of Life Issues, New Faculty Briefing Workshop

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## **MASTER OF BUSINESS ADMINISTRATION**

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### **COMMANDING OFFICERS' STANDING ORDERS: A POWERFUL AND UNIQUE GENRE**

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**Master of Business Administration-March 2006**

**Advisors: Cynthia King, Graduate School of Business and Public Policy**

**James Suchan, Graduate School of Business and Public Policy**

Commanding officers' standing orders are critical to shipboard watch standing. Written by the captain and used by watch standers, standing orders perform many unique and powerful functions aboard ships. Using genre theory, this study provides insight into the specific roles standing orders play. This insight also provides deeper perspective into commanding-officer (CO) to watch-stander relationships, as well as the nature of CO power aboard ships. A deeper understanding of the role standing orders play provides a new perspective on shipboard relationships, communication, and culture. In turn, this new perspective can lead to reevaluation of standing-order function and use.

**KEYWORDS:** Commanding Officer, Leadership, Genre Theory, Genre Analysis, Communication, Written Communication, Organizational Communication, Standing Orders, Power

### **A STUDY ON THE POTENTIAL COST SAVINGS ASSOCIATED WITH IMPLEMENTING AIRLINE-PILOT TRAINING CURRICULA INTO THE FUTURE P-8 MULTI-MISSION MARITIME AIRCRAFT (MMA) FLEET REPLACEMENT SQUADRON**

**Jay S. Vignola-Lieutenant, United States Navy**

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**Associate Advisor: Keith F. Snider, Graduate School of Business and Public Policy**

This thesis discusses potential cost savings associated with implementing airline pilot training curricula into the future P-8 Multi-Mission Maritime Aircraft (MMA) Fleet Replacement Squadron (FRS). These curricula rely primarily on high-technology flight simulators and do not require any flight time in an actual aircraft. This thesis also provides an approach for estimating future P-8 FRS cost savings. Results of this thesis indicate that significant savings will likely accrue in the areas of fuel, Aviation Depot Level Repairables (AVDLR), and training expendable stores costs if airline pilot training curricula are implemented into the P-8 FRS in fiscal year 2014. Further research is needed in many other cost areas before additional cost savings estimates can be made. Finally, this thesis discusses many additional considerations that should be taken into account before a future airline pilot training curricula implementation decision is made.

**KEYWORDS:** Flight Simulator, Flight Simulators, Fleet Replacement Squadron, FRS, MMA, Multimission Maritime Aircraft, P-8, Pilot Training

### **BUSINESS ORGANIZATIONAL SYSTEMS FRAMEWORK MODEL APPLICABILITY AND ANALYSIS**

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**Master of Business Administration-December 2005**

**Sarah Jean Sharpe-First Lieutenant, United States Air Force**

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**Advisors: Nancy C. Roberts, Graduate School of Business and Public Policy**

**Cary Simon, Graduate School of Business and Public Policy**

For this project, the organizational systems framework (OSF) model is used, coupled with the skills learned through MBA core courses, to analyze a local business, address possible organizational problems, and provide recommendations for change. This project helps the organization define/redefine its mission, understand its competitive advantage, and increase its overall long-term profit objectives. Researchers take the lessons learned from this analysis and consider their applicability to DoD. This MBA project is used primarily to become familiar with the OSF model through a real world business analysis.

# **MASTER OF SCIENCE**

**Applied Mathematics**  
**Applied Physics**  
**Computer Science**  
**Defense Analysis**  
**Electrical Engineering**  
**Information Operations**  
**Information Systems and Operations**  
**Information Technology Management**  
**Leadership and Human Resource Development**  
**Mechanical Engineering**  
**Meteorology**  
**Meteorology and Physical Oceanography**  
**Modeling, Virtual Environments, and Simulation**  
**Operations Research**  
**Physical Oceanography**  
**Physics**  
**Program Management**  
**Software Engineering**  
**Systems Engineering**  
**Systems Technology**



# MASTER OF SCIENCE IN APPLIED MATHEMATICS

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## MODELING FLUID FLOW BY EXPLORING DIFFERENT FLOW GEOMETRIES AND EFFECT OF WEAK COMPRESSIBILITY

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Atmospheric mixing is a problem of exceptional importance and it is difficult to study. The anelastic approximation is the accepted fluid system governing the atmosphere over large vertical scales (about eight km). The anelastic equations, unlike the Navier-Stokes equations, incorporate a nontrivial spatial divergence constraint on the velocity field. This yields a weakly compressible fluid flow. The basis of this study is to use numerical analysis to explore the effects of weak compressibility in the evolution of fluid governed by the anelastic equations, and the effects of incompressibility governed by the Navier-Stokes equation. The analysis also investigates the difference between three different initial conditions. Within each initial condition, different density profiles are observed while varying parameters are investigated. Numerical results show that comparisons of incompressible Navier-Stokes equations to the anelastic fluid flow equations do not produce similar results. The weakly compressible flow creates a mixing barrier, stopping vertical fluid exchange. The perturbed middle region initial condition creates a chaotic environment that prevents vortices from merging.

**KEYWORDS:** Navier-Stokes Equation, Anelastic Equations, Numerical Analysis, Incompressible Fluid Flow, Weakly Compressible Fluid Flow



# MASTER OF SCIENCE IN APPLIED PHYSICS

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## DEMONSTRATION OF WAYPOINT NAVIGATION FOR A SEMI-AUTONOMOUS, PROTOTYPE SURF-ZONE ROBOT

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**Second Reader: Ravi Vaidyanathan, Department of Systems Engineering**

The objective of the small-robot technology (SMART) initiative at the Naval Postgraduate School is to develop robots for military use. One of the goals of this program is to create a surf-zone reconnaissance robot to conduct beachhead surveillance and mine detection. To this end, a prototype robot is created to test the locomotion and navigation functions that will be used on the surf-zone robot. This work consists of redesigning the steering mechanism, strengthening the structure, improving the electrical distribution, and upgrading the communications hardware. Several tests are conducted on both grass and soft sand to evaluate the performance of the locomotion system and the navigation software. The results demonstrate that the robot functions best in soft sand, as expected. However, several serious mechanical design flaws are noticed in the body construction and mechanical systems. These flaws, while not detrimental, negatively impact the performance of the system. Finally, some suggestions for improving future prototypes are discussed.

**KEYWORDS:** Amphibious, Autonomous, Robotics, Surf-Zone, Whcg

## CHARACTERIZATION AND ANALYSIS OF A MULTICOLOR QUANTUM-WELL INFRARED PHOTODETECTOR

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This thesis presents analysis and characterization of performance of a newly designed, multicolor quantum-well infrared photodetector (QWIP). Specifically, it focuses on a detector capable of detecting infrared emissions in the near infrared (NIR), mid-wavelength infrared (MWIR), and long-wavelength infrared (LWIR). Through photocurrent spectroscopy and performance analysis, this prototype detector can be classified and prepared for possible future use within the U.S. armed forces. Certain military applications require a highly accurate, reliable, sensitive, and multispectral infrared detector to identify targets and ensure mission success. By designing and fabricating a multicolor quantum well infrared photodetector, simultaneous detection of targets in the near infrared, mid-wavelength infrared, and long-wavelength infrared is possible using only one detector. In addition, power and cooling requirements for quantum well infrared detectors make them suitable for use in the field.

**KEYWORDS:** Quantum Well, QWIP, Three-Color Detection, Infrared Detection, Photocurrent Measurement, I-V Curve Measurement

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## APPLIED PHYSICS

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### LOW-VOLTAGE ELECTROLYTIC CAPACITOR PULSE-FORMING INDUCTIVE NETWORK FOR ELECTRIC WEAPONS

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**Second Reader: Peter P. Crooker, Department of Physics**

Electric weapons, such as the railgun, require a pulse power supply capable of providing reliable high-current high-energy pulses of many megawatts. Pulsed alternators potentially have the same maintenance issues as other motor-generator sets, so a solid-state system would be desirable, but high voltage capacitor systems are not robust enough for the field. In this research, a Low Voltage Electrolytic Capacitor Pulse Forming Inductive Network (LVEC PFIN) is proposed. This LVEC PFIN stores power in a relatively low voltage capacitor bank and provides weapon power pulses by first draining the capacitors into a power inductor and then interrupting the flow of current via a switch counterpulsing technique in order to achieve railgun-appropriate voltages. For this thesis, a 13 kJ LVEC PFIN is constructed, using solid-state semiconductor switches to redirect 25 kA of current into a 1 m $\Omega$  load, and the redirection of larger currents is clearly feasible. This technique may be a viable alternative once the energy densities and equivalent series resistances of low voltage capacitors and ultracapacitors reach the necessary levels.

**KEYWORDS:** Counterpulsing, Low Voltage Electrolytic Capacitor Pulse Forming Inductive Network, LVEC PFIN, Railgun, Electric Weapons, Inductive Storage, Solid-State Opening Switch, IGCT

### HIGH-POWER-AMPLIFIER FREE-ELECTRON LASERS

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The free electron laser (FEL) is among the latest technologies of interest to the U.S. military, in particular, the Navy. In Naval applications, FEL would serve as a self-defense weapon system, protecting the ship from an array of threats, including anti-surface cruise missiles and small boats. This system's potential range and deep magazine make it ideal as point defense against incoming missiles. Its inexpensive cost of only a few dollars per engagement and multi-mission capability makes this future weapon system superior to the short-range missile-defense systems employed today. The most powerful FEL is currently located in Jefferson Lab, operating at 10 kW, two orders of magnitude short of the 1 MW power level required for weapons application. This thesis describes the components and theory of operation of the FEL and analyzes two competing designs for the next step in the evolution of the future weapon system, the 100 kW FEL, proposed by Brookhaven and Los Alamos National Labs. Due to advances in Naval Postgraduate School simulation techniques for the amplifier configuration, a more in depth analysis that includes the effects of electron beam tilt and shift is performed for the first time on these proposed designs.

**KEYWORDS:** Free Electron Laser, High Energy Lasers, FEL, Amplifier, High Power Lasers

## TRANSPORT IMAGING IN THE ONE-DIMENSIONAL LIMIT

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Transport imaging is a scanning electron microscope (SEM)-based technique used to directly image the motion and recombination of charge in luminescent semiconductors, allowing for the extraction of transport parameters critical to device operation. In this thesis, transport imaging for one-dimensional (1D) structures is initiated with work on sample preparation, modeling, and initial characterization. One-dimensional structures are being integrated into forefront electronics due to their inherent advantages in size, packing density, and power consumption. In this work, the one-dimensional equation for steady state minority carrier recombination distribution solved for the Gaussian source is derived and results from numerical simulations are presented. The diameter of the SEM beam is determined experimentally, allowing for accurate simulation parameters. Intensity and drift measurements on four batches of top-down wire structure samples, fabricated on an AlGaAs/GaAs/AlGaAs double heterostructure using a focused ion beam (FIB), are presented. Significant decreases in luminescence in FIB exposed regions are reported. Spatial luminescence from single bottom-up gallium nitride (GaN) and ZnO nanowires deposited by metal initiated metal-organic chemical-vapor deposition on Au and SiO<sub>2</sub> substrates is imaged. Cathodoluminescence (CL) spectra for GaN and ZnO, with peak intensities at 3.27 and 3.29 eV, are characterized. Finally, several suggestions for further research are offered, including transport imaging on contacted bottom-up nanowires and a potential application of transport imaging to FIB damage characterization.

**KEYWORDS:** Nanowire, Transport Parameters, FIB Damage, GaN, ZnO, Transport Imaging



# MASTER OF SCIENCE IN COMPUTER SCIENCE

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## AN EMPIRICAL EVALUATION OF A FACTOR EFFECTS SCREENING PROCEDURE FOR EXPLORING COMPLEX SIMULATION MODELS

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Screening experiments are procedures designed to identify the most important factors in simulation models. Previously proposed one-stage procedures, such as sequential bifurcation (SB) and controlled sequential bifurcation (CSB), require factor effects to be arranged according to estimated sign or magnitude prior to screening. FF-CSB is a two-stage screening procedure for simulation experiments proposed by Sanchez, et al. (2005), which uses an efficient fractional factorial experiment to estimate factor effects automatically, removing the need for pre-estimation. Empirical results show that FF-CSB classifies factor effects as well as CSB in fewer runs when factors are grouped by sign only (positive or negative). In theory, the procedure can achieve more efficient run times when factors are also sorted by estimated effect after the first stage. This analysis tests the efficiency and performance characteristics of a sorted FF-CSB procedure under a variety of conditions and finds that the procedure classifies factors as well as unsorted FF-CSB with significant improvement in run times. Additionally, various model- and user-determined scenarios are tested in an initial attempt to parameterize run times against parameters known or controlled by the modeler. Further experimentation is also suggested.

**KEYWORDS:** Factor Effects Screening, Screening Experiments, Controlled Sequential Bifurcation, Simulation Experiments

## SHIP AND INSTALLATION PROGRAM: OPTIMAL STATIONING OF NAVAL SHIPS

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**COL William J. Tarantino, USA, Graduate School of Operational and Information Sciences**

**Second Reader: CAPT S. Starr King, USN , Department of Operations Research**

Beginning in 1988, Congress authorized the Department of Defense to conduct five rounds of base realignment and closure (BRAC), including the most recent round in 2005. BRAC provides the DoD with a politically insulated evaluation and reorganization of its installations. For BRAC 2005, the Department of the Navy (DoN) used an integer linear program called configuration analysis to determine installation closures. Using constraints that maintain adequate pier capacity and unique capability installations, Configuration analysis seeks to maximize a measure of military value while penalizing excess capacity for a set of open installations. This thesis extends the Navy's configuration analysis to incorporate cost and ship stationing for the set of surface and subsurface installations. The modified integer linear program is called the ship and installation program (SHIP). SHIP provides a minimum cost stationing for the given set of surface and subsurface ships and installations while maintaining operational feasibility and a required level of military value. Using data mainly drawn from the DoN BRAC 2005 data call, the tradeoff between cost and military value is evaluated using SHIP's 20-year net present value (NPV). Requiring higher levels of aggregate military value results in higher cost, expressed in SHIP as higher NPV. Conversely, accepting

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lower levels of military value could potentially allow the DoN to realize \$3.2 billion in savings. Researchers also investigate the influence of using two different measures of pier capacity and incorporate 30 new ships and submarines to demonstrate SHIP's ability to station the proposed future force structure.

**KEYWORDS:** Base Realignment and Closure, BRAC, Integer Linear Programming

### **A GAME-THEORETIC MODEL FOR REPEATED HELICOPTER ALLOCATION BETWEEN TWO SQUADS**

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A Platoon commander has a helicopter to support two squads, which encounter two types of missions—critical or routine—on a daily basis. During a mission, a squad always benefits from having the helicopter, but the benefit is greater during a critical mission than during a routine mission. Because the commander cannot verify the mission type beforehand, a selfish squad would always claim a critical mission to compete for the helicopter, which leaves the commander no choice but to assign the helicopter at random.

In order to encourage truthful reports from the squads, a token system is designed that works as follows. Each squad keeps a token bank, with tokens deposited at a certain frequency. A squad must spend either one or two tokens to request the helicopter, while the commander assigns the helicopter to the squad that spends more tokens, or breaks a tie at random. The two selfish squads become players in a two-person non-zero-sum game. The Nash equilibrium of this game is found, and numerical examples are used to illustrate the benefit of the token system.

**KEYWORDS:** Game Theory, Nash Equilibrium, Markov Chain

### **USE OF WEBDAV TO SUPPORT A VIRTUAL FILE SYSTEM IN A COALITION ENVIRONMENT**

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

The Monterey Security Architecture (MYSEA) combines untrusted commercial, off-the-shelf components with specialized high-assurance trusted components to provide a trusted multilevel secure environment. However, MYSEA currently lacks a means of providing remote access to data on the MYSEA server, a vital service for users in any client-server environment. Access and interaction with both public and private server-resident data that is constrained by the underlying discretionary and mandatory access control policy enforcement mechanisms of the MYSEA server is required.

By enabling the use of WebDAV in MYSEA, this thesis provides a means for fulfilling the above requirement for secure remote access by creating a virtual web-based file system accessible from the MYSEA multilevel secure network. This is accomplished by incorporating the mod\_dav module into the Apache web server already installed on the MYSEA server. The use of a module requires minimal changes to add the desired functionality. Integration of mod\_dav is performed in three stages to aid in tracing the source of any errors. Functional and security testing is also performed, ensuring that the functional and security requirements are fulfilled. This research is relevant to the DoD global information grid's vision of assured information sharing.

**KEYWORDS:** Monterey Security Architecture, WebDAV, Multilevel File Sharing

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## **APPLYING SEMANTIC WEB CONCEPTS TO SUPPORT NET-CENTRIC WARFARE USING THE TACTICAL ASSESSMENT MARKUP LANGUAGE (TAML)**

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**Master of Science in Computer Science-June 2006**

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**Curtis L. Blais, MOVES Institute (Modeling, Virtual Environments and Simulation)**

**Second Reader: CAPT Paul Young, USN, United States Naval Academy**

The ability to analyze data quickly and transform it into important information is vital for information superiority. However, the amount of available data is increasing and the time available to make decisions is decreasing. There is too much data for humans to sift through and filter for decision making, so computer automation is necessary. The current approach to automating data processing is to hard-code programs to parse particular data formats, but this approach is not flexible enough to handle the constantly changing data world. The Extensible Markup Language (XML) offers a partial solution by providing a syntactic standard for data exchange. The Tactical Assessment Markup Language (TAML) is an XML vocabulary for exchanging undersea warfare tactical data that provides a standard syntax for message exchange. However, the meaning or semantics of the data is unknown to the machine processing the data.

The semantic web is a set of technologies designed to add semantic information to data for machine processing. The technologies consist of several components, including a common syntax for data exchange, common semantic representation, and a common ontology language. The Resource Description Framework (RDF) is used to explicitly state the relationships between resources or entities. The Web Ontology Language (OWL) is used to build models that explicitly define the concepts and properties in a domain. Since concept definitions are written in standard languages, a variety of reasoning engines might be used to process any ontology and its corresponding data instances. Reasoning engines can also apply algorithms to the data to infer useful information and present it to decision makers. Thus, there is far less need for specialty hard-coded programs or proprietary data-representation schemes to hold semantic information, since the information needed to process data is captured in an OWL ontology, itself stored in XML format for exchange between systems.

Building ontologies for specific domains, such as the undersea warfare, allows programs to understand, process, and infer new information from coherent data. Applying semantic web technologies to XML languages, such as TAML, brings the armed forces closer to a knowledge-aware global-information grid (GIG).

**KEYWORDS:** Extensible Markup Language, XML, Global Information Grid, GIG, Semantic Web, Tactical Assessment Markup Language, TAML, Web Ontology Language, OWL, Resource Description Framework, RDF, Semantic Web Rule Language, SWRL

## **AN ANALYSIS OF SPECWARE AND ITS USEFULNESS IN THE VERIFICATION OF HIGH- ASSURANCE SYSTEMS**

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**Cynthia E. Irvine, Department of Computer Science**

Formal verification is required for systems that require high assurance. Formal verification can require large and complex proofs that can drastically affect the development lifecycle. Through the use of a verification system, such proofs can be managed and completed in an efficient manner. A verification system consists of a specification language that can express formal logic, and an automated theorem tool that can be used to verify theorems and conjectures within the specifications. One example of a verification system is Specware. This thesis presents an analysis of Specware against a set of evaluation criteria in order to determine the level of usefulness Specware can have in the verification of high assurance systems. This analysis reveals that Specware contains a powerful specification language capable of representing higher order logic in a simple and expressive manner. Specware is able to represent multiple levels of abstraction and generate proof obligations regarding specification correctness and interlevel mapping. The theorem

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prover associated with Specware is found to be lacking in capability. Through this analysis, it is found that Specware has great potential to be an excellent verification system given improvement upon the theorem prover and strengthening of weaknesses regarding linguistic components.

**KEYWORDS:** Verification, High Assurance Systems, Separation Kernel, Specware, Refinement, Theorem Prover, Information Assurance

### **DEVELOPMENT OF METHODOICAL SOCIAL ENGINEERING TAXONOMY PROJECT**

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**Neil C. Rowe, Department of Computer Science**

Since security is based on trust in authenticity as well as trust in protection, the weakest link in the security chain is often between the keyboard and the chair. Humans have a natural willingness to accept someone at his or her word. Attacking computer systems via information gained from social interactions is a form of social engineering. Attackers know how much easier it is to trick insiders instead of targeting the complex technological protections of systems. In an effort to formalize social engineering, two models are built: Trust and Attack. Because social-engineering attacks are complex and typically require multiple visits and targets, these two models can be applied, individually or together, at various times to each individual attack goal.

**KEYWORDS:** Deception, Trust, Taxonomy, Countermeasure

### **A FRAMEWORK FOR THE MANAGEMENT OF EVOLVING REQUIREMENTS IN SOFTWARE SYSTEMS SUPPORTING NETWORK-CENTRIC WARFARE**

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The capabilities required to support network-centric operations (NCO) in the network-centric warfare (NCW) environment must be supported by new, innovative, networked, communication technologies. There are many sources of requirements for these software systems supporting NCO, which may increase in number as the services continue to develop the capabilities necessary to transform to a fully networked military force. Requirements may also emerge and continue to evolve following the fielding of an NCO capability. Requirements evolution results in requirements engineering challenges associated with the acquisition and development of network-centric software systems.

The purpose of this research is to address the problem of evolving requirements. The requirements-engineering framework proposed by this thesis incorporates classification theory and requirements modeling principles, and is supported by the Extensible Markup Language (XML) family of technologies. Particular attention has been paid to the selection of non-proprietary, platform independent technology to ensure that data can be exchanged between organizations.

The framework demonstrates a means by which requirements can be classified and structured in a standardized format. This approach captures evolving software requirements of fielded network-centric software systems for use in the development of future systems.

**KEYWORDS:** Requirements Engineering, Requirements Evolution, Faceted Classification, Extensible Markup Language, XML, Unified Modeling Language, UML

# MASTER OF SCIENCE IN DEFENSE ANALYSIS

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## ENHANCING NATIONAL SECURITY IN HUNGARY THROUGH THE DEVELOPMENT AND EMPLOYMENT OF SPECIAL FORCES

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**M.A., National Defense University, 2003**

**Master of Science in Defense Analysis-June 2006**

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**George Lober, Department of Defense Analysis**

This thesis establishes an analytical framework for identifying and discussing strategic factors considered when developing the Hungarian Special Forces (HUNSF) as a new “niche” capability of the Hungarian Defense Forces (HDF). Although the findings have broad application, focus is on the Hungarian Special Forces unit. Key questions include: how will factors such as the strategic environment, changes in the nature of war, and characteristics of potential adversaries affect the development of a conceptual framework for the Hungarian Special Forces? Should unconventional warfare (which is a capability gap in the HDF at present) be an official task for the future Hungarian military forces, and specifically, a primary task for the HUNSF? Central to this study are factors found in the strategic environment, such as Hungary’s affiliation with NATO and the European Union (EU). The thesis concentrates on defining the tasks for HUNSF, and based on these tasks, develops an organizational framework for the HUNSF capability. This framework includes training and command and control. The constantly changing security environment will also call for adjustments to the concept of HUNSF in the future; therefore, a vision for the HUNSF is incorporated into the thesis to provide flexibility and guidance for capability development in the future.

A key finding of the thesis is that HUNSF has the potential to contribute to the fight against the many new security challenges and achieve many of the objectives posited in existing military transformation strategies, most importantly, an unconventional warfare capability.

**KEYWORDS:** Low Intensity Conflict, Strategy, Hungary, Special Forces

## EXPLORATIONS ON JUST WAR: HAS IT EVER EXISTED?

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In this thesis, examples are presented of non-adherence to just-war doctrine and researchers challenge whether the theory ought to be adhered to at all. This research is based on nation-to-nation and nation-to-international-actor wars and addresses all three tenets of the just-war doctrine: *jus in bello*, *jus ad bellum*, and *jus post bello*. The author’s writings suggest that since just-war theory has not been adhered to in its entirety within the last hundred years, standing by the theory may, in itself, be irrelevant. This theory was created to make addressing, committing, and ending war the gravest of all man’s acts, so severe in nature that there is no room for error. In fact, during the research of this thesis, a war that was fought justly according to tradition was not found. Further, because just-war doctrine decreed that in order for a war to exist justly, all tenets must be followed, this thesis provides considerable evidence that for the last hundred years the just-war doctrine has not been adhered to, and with the changing dimensions of warfare by terrorists, state, and rogue actors, and increased interconnectedness through globalization, just-war may never be relevant as it was in the early years of its establishment.

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**KEYWORDS:** Just War Doctrine, Preemption, Globalization, Terrorism

### **“EOD, UP!:" HOW EXPLOSIVE-ORDNANCE-DISPOSAL FORCES CAN BEST SUPPORT SPECIAL-OPERATIONS FORCES**

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U.S. Special-Operations Forces (SOF) are likely to undertake missions against terrorists, insurgents, and other enemies where they will encounter explosive hazards. Identification, detection, and neutralization of weapons of mass destruction, improvised explosive devices, booby-traps, and similar weapons requires the support of technicians trained in explosive-ordnance disposal (EOD), an expertise that is not resident in SOF units. Consequently, there is a need for EOD technicians with SOF capabilities who can readily integrate with SOF units. This thesis employs a variety of methodologies, from an analysis of required capabilities to an application of game theory, to determine how SOF can be best supported by existing EOD forces and how the supporting command structures and relationships may be improved. This thesis concludes that the Navy's EOD force is best suited to provide support to SOF, and should be included in all special operations planning documents. Those Navy EOD units tasked to provide support to SOF should be consolidated into one organization dedicated to that mission. Finally, when supporting SOF, the Navy should replace its current eight-person EOD operational element with a two-man team that will better match SOF operational requirements.

**KEYWORDS:** Explosive Ordnance Disposal, EOD, Special Operations Forces, SOF, Hyper-Conventional, SOF Support, Force Enablers, Game Theory, SWAT, Initial Trust, Technical Intelligence, Hostage Rescue, Requirements Analysis, Counter-Terrorism, Improvised Explosive Device, IED

### **UNCONVENTIONAL COUNTERINSURGENCY IN AFGHANISTAN**

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Immediately following the attacks of September 11, 2001, a small number of U.S. Army Special Forces (USSF) invaded the Al Qaeda safe haven of Afghanistan. USSF A-teams, operating with almost total independence, conducted highly successful Unconventional Warfare “through, with, and by” the indigenous Afghan militias of the Northern Alliance. The USSF and their indigenous Afghan armies rapidly deposed the Taliban regime and denied the Al Qaeda terrorists their training and support areas within Afghanistan. The momentum of the initial success achieved by USSF during 2001-2002, however, has been dramatically overshadowed by the inability of follow-on U.S. forces to establish long-term stability in post-Taliban Afghanistan. Since 2002, the conventional U.S./Coalition forces, which replaced Army USSF as the main U.S. counterinsurgency (COIN) forces, have thus far failed to defeat the re-emerging Taliban/Al Qaeda threat. In fact, 2005 has been the most violent year to date for U.S./Coalition forces serving in Afghanistan, with 239 U.S. casualties and President Hamid Karzai's central Afghan government exhibiting little control outside its major cities. This trend continues in 2006. In this thesis, researchers question the current U.S./Coalition campaign plan, which places emphasis on conventional military forces, not USSF, as the main effort COIN force in Operation Enduring Freedom. An alternative Unconventional COIN model is proposed, which focuses on population control instead of “clear and sweep operations,” Afghan constabulary-style forces instead of conventional Afghan National Army troops, the

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importance of “grassroots” intelligence collection at the village level, and the employment of USSF advisors instead of conventional U.S. infantry troops.

**KEYWORDS:** OEF, Insurgency, Counterinsurgency, Unconventional Warfare, COIN, PRC, Constabulary Force, Militia, Warlords, Afghanistan, U.S. Strategy, Military Strategy, GWOT, Special Forces, SF, USSF

### **INSURGENCY IN THE HOOD: UNDERSTANDING INSURGENCIES THROUGH URBAN GANGS**

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Past, current, and future military endeavors will invariably involve conflict at the sub-state level. A recurring problem in the study of insurgent conflict is a lack of data that has the breadth, depth, and historical accuracy to provide insight as to why, at the individual level, people participate in insurgency. Accessibility to street gangs provides a comprehensive source of data not seen in insurgencies. Street gangs provide a “ground truth” to the interaction between the state and organized sub-state groups in a competition for control.

The individuals who fuel both sides of this competition for control are basing decisions to participate in insurgency on a framework founded in rational actor theory, but modified by their perspective of the world. Groups who wish to recruit individuals into their insurgency apply incentives and disincentives selectively to individuals to compel membership. As a group gains more members, it can apply more incentives, increasing the rate of future recruitment and the level of control over a community.

A comprehensive and effective strategy cannot be developed to counter these insurgent forces without first answering the fundamental questions behind individual participation. This thesis examines insurgency from the individual level and proposes concepts that must accompany any attempt to combat rebel groups.

**KEYWORDS:** Insurgency, Gangs, Social Movement Theory, Rational Actor Model, Collective Action, Gang Participation

### **INTEGRATED SWARMING OPERATIONS FOR AIR BASE DEFENSE: APPLICATIONS IN IRREGULAR WARFARE**

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In this thesis, the lack of doctrine and guidance when it comes to fighting irregular warfare campaigns is discussed. Over the past 60 years, the Department of Defense has had an appalling record of protecting its air bases and personnel while deployed around the world in support of these low intensity conflicts. The way the military defends and protects these air bases still revolves around a Cold War threat, a conventional threat. To enhance combat capabilities in the Air Force and to defeat irregular warfare (IW) forces in any environment, this thesis presents a concept of Integrated Swarming Operations (ISO); the complete integration of a highly trained security force, skilled in the employment of successful counterinsurgency tactics, techniques, and procedures (TTPs), with today’s most sophisticated command, control, communications, computer and intelligence, surveillance, and reconnaissance (C4ISR) platforms into a battlefield swarm. In doing so, ISO allows security forces to achieve their three critical air base defense Mission Essential Tasks (METs) of 1) tactical ISR, 2) intercepting the threat, and 3) application of

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force, as well as the Air Force's integrated-base defense (IBD) objectives of "see first, understand first, and act first."

**KEYWORDS:** Air Base Defense, Insurgency, Counterinsurgency, Guerilla Warfare, Base Defense, Security Forces, Command, Control, Communication, and Computer Intelligence, Surveillance and Reconnaissance, C4ISR, Integrated Base Defense Objectives, Mission Essential Tasks

### **BRIDGING THE GAP: HISTORICAL ANALYSIS OF CONVENTIONAL AND UNCONVENTIONAL FORCES INTEGRATION**

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Throughout American history, there has been tension between conventional and unconventional forces, both on the field and between the commanders; this is even seen at the strategic level. Force misperceptions created a gap between U.S. conventional and unconventional forces that reached a peak at the conclusion of the Vietnam War. This gap has slowly been reduced with the creation and efforts of the Special Operations Command (SOCOM); however, inefficiencies in the conduct of major combat campaigns still remain as a result of poor integration.

The Burma Campaign and the liberation of the Philippines (1942-1945) provide two unique case studies in which unconventional forces worked under the overall guidance and command of a conventional leader. Throughout the Burma Campaign and the struggle for the liberation of the Philippines, conventional forces relied heavily on the ability of unconventional forces to support and contribute to the overall campaign strategy. Direct and indirect communication, coordination, and autonomy of operations between these forces resulted in strategic successes en route to victory in World War II. The coordination and roles of these forces throughout the campaigns provide valuable insights and lessons learned that can be applied to today's forces, who continuously integrate in U.S. conflicts abroad.

**KEYWORDS:** Unconventional Warfare, Special Operations Forces, Conventional Forces, Integration

### **WHAT IS THE ROLE OF NEGOTIATIONS WHEN COUNTERING AN INSURGENCY?**

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Within today's irregular warfare environment, negotiations with insurgents are difficult. This is in part because insurgents are often characterized as terrorists. Early in the Iraqi conflict, there was a perceived notion that the insurgent and the terrorist were morphing into one entity. This perceived morphing being the case, some U.S. policy makers and senior military leaders have been reluctant to negotiate with Iraqi insurgents. Acknowledging this reluctance, this thesis focuses on the role of negotiations in countering insurgencies. During the examination of historical cases of negotiations with insurgents, this thesis identifies commonalities within the case studies and tests the thesis' hypotheses about the potential usefulness of negotiations as an element of counterinsurgency strategy. The conceptual framework for the case studies utilizes several publications and articles to determine the feasibility and suitability of the information collected from the case studies themselves, in order to determine the role negotiations can play in countering an insurgency. The insights gathered from the historical case studies and analysis of the conceptual framework serve as the foundation to construct a notional negotiation strategy to counter the insurgency in Iraq. In conjunction with the information gathered from the historical case studies and a literary survey, this thesis applies a theoretical model and defines terms to act as steering mechanisms when developing a notional negotiation strategy.

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**KEYWORDS:** Negotiation Strategy, Countering Insurgencies, Negotiation Roles, Coercion and Cooperation, Insurgents Dilemma, Compartmentalized Negotiations, Negotiations Key Individuals, Good Faith Negotiations, Strongman Intervention, Conflict Resolution, Insurgent

### **ENHANCING HUMAN RESOURCE CAPABILITY IN THE TANZANIAN PEOPLE'S DEFENSE FORCE (TPDF)**

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The Tanzanian People's Defense Force (TPDF) was established as a people's army entrusted with the traditional roles and missions of defending the United Republic of Tanzania against external enemies. The end of the Cold War and the collapse of the Soviet Union changed the strategic environment. Refugees from conflict-torn areas, poaching, small-arms proliferation, political fundamentalism, drug trafficking, transnational terrorism, and environmental degradation threaten internal security. At the regional level, the TPDF, with the militaries of other countries, has been deployed in conflict areas through regional bodies such as the East African Community (EAC) and South African Development Community (SADC) on issues of collective defense and security. Technological developments also call for a military with the capability to operate modern weaponry systems and to operate in a complex environment.

This thesis argues that innovative thinking has to be developed to enable the TPDF to meet conventional and unconventional military demands through the development of its human resources.

**KEYWORDS:** Human Resource Management, Personnel Capabilities, Peoples Militia, Manpower, Career Development

### **RADIO-FREQUENCY IDENTIFICATION (RFID) MEETS GWOT: CONSIDERING A NEW TECHNOLOGY FOR A NEW KIND OF WAR**

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**Second Reader: Dorothy Denning, Department of Defense Analysis**

The purpose of this thesis is to provide insight into the potential benefits that radio-frequency identification (RFID) technology may provide U.S. Special Operations Command (USSOCOM) and other commands in the global war on terrorism. This thesis explains the basic concept behind RFID, and cites some of the current day applications that are revolutionizing the civilian sector. More importantly, this thesis introduces conceptual security applications that could benefit USSOCOM today, highlighting the possible successes and downfalls that these applications might include.

**KEYWORDS:** Radio Frequency Identification, Security Applications, Insurgency, Counterinsurgency

### **CHINESE MOVEMENTS AND SOCIAL CONTROLS**

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The purpose of this thesis is to explore and analyze the threat posed by certain social movements during the post-Mao reform era and the various methods of social control used by the Chinese government to deal with them. The thesis uses historical data and three case studies to examine the influence and popularity of

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social movements and methods of control, from surveillance to physical intimidation to imprisonment and forced exile. The thesis also explores the evolution of social control over decades of social change in China. What characteristics of a social movement threaten the Chinese Communist Party (CCP)? Does the CCP have a preferred method of social control, and has that method withstood the test of time? Does the increasing number of protests signify that China is losing control over its population? What does the future hold?

**KEYWORDS:** China, Social Movements, Social Controls, Tiananmen Square, China Democracy Party, Falun Gong

### **THE USE OF SPECIAL OPERATIONS FORCES IN COMBATING TERRORIST FINANCING**

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With United States Special Operations Command (USSOCOM) being given the role as the lead Combatant Command in fighting the Global War on Terrorism (GWOT), USSOCOM must examine ways to engage terrorists on a global scale. USSOCOM must look at means other than direct action to defeat these terrorist networks. It must also look at the entire network and not just the cells that carry out the terrorist operations.

Terrorist financing is an integral part of the GWOT, though thus far it has mostly been pursued by law enforcement agencies rather than the U.S. military. This is due to the perception that terrorist financing is criminal in nature and therefore relegated to law enforcement agencies, rather than a threat to national security that would be the responsibility of the military.

This thesis serves two purposes. The first is to analyze whether the U.S. military and Special Operations Forces (SOF) in particular should look at terrorist financing as part of the military's role in the GWOT and what that possible role could be. The second is to look at how SOF could organize itself in order to carry out such a role should it be necessary to do so. Ironically, during the time this thesis was being written, the Department of Defense has determined that SOF does have a role in terrorist financing and that USSOCOM will be the executive agent for the DoD with regards to terrorist financing.

**KEYWORDS:** Terrorist Financing, Threat Finance, United States Special Operations Command, Global War on Terrorism, Special Operations Forces, Special Operations Command, Special Operations Debrief and Retrieval System, Inter-Agency Cooperation

### **TRANSFORMING NORWEGIAN SPECIAL-OPERATION FORCES**

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This thesis explores the transformation of Norwegian Special Operation Forces (NORSOF), raising the hypothesis that current organizational structure is inconsistent with future roles and missions. The inconsistency is derived from official documents pertaining to the transformation of the Norwegian Armed Forces for the period 2005-2008. Where the military recommends disbanding two existing units, Marinejegerkommandoen and Hærens Jegerkommando, to re-commission a single unit under a single, unspecified command, the government insists on maintaining the status quo. A likely consequence is a sub-optimal development of NORSOF as a strategic asset.

Using the dichotomy of direct action versus indirect action capabilities as a framework for understanding how Special Operation Forces (SOF) conduct operations in general, the author claims NORSOF possess capabilities only for the former. Analysis of the forces themselves, the security environment, and the strategies adopted to deal with current and future threats leads to the conclusion that NORSOF will increase its relevance by acquiring competency in indirect capabilities. If indirect

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capabilities become a core task for NORSOFF, then the current organization should be maintained. If not, both units will continue to maintain overlapping tasks in direct capabilities. Future transformation issues will then evolve based on traditional arguments related to maritime and land domains.

**KEYWORDS:** Special Operation Forces, Transformation, Cold War, Military Doctrine and Organization, Norway

### **ONE STEP BACK, TWO STEPS FORWARD: AN ANALYTICAL FRAMEWORK FOR AIRPOWER IN SMALL WARS**

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Airpower capability and military technology have created a vision of airpower that focuses on the lethality of weaponry instead of the use of that weaponry as a political tool. Unfortunately, by definition, such a lethality-focused force optimized to fight interstate conflicts ensures that this force is sub-optimal for waging wars at the sub-state level. Small wars are conflicts where the political and diplomatic context, and not the military disposition of the combatants, is usually the determining factor. Following World War II, there emerged an era of insurgencies and limited wars of territorial dispute. These small wars required new operational and tactical innovations involving the use of airpower, as the very nature of these wars differed from conventional conflict towards which most of aviation was geared. This thesis analyzes six historical cases involving the use of airpower across a wide spectrum of small wars through the lens of an analytical framework for countering insurgencies. While the typologies of no two conflicts are identical, and the application of airpower equally varied, this work provides fundamental assertions and implications regarding the proper use of airpower for waging war at this level.

**KEYWORDS:** Airpower, Small War, Leites and Wolf, Insurgency, Counterinsurgency, Malaya, Falklands, Indochina, Algeria, Philippines, Huk Rebellion, El Salvador

### **SPECIAL FORCES AND THE ART OF INFLUENCE: A GRASSROOTS APPROACH TO PSYCHOLOGICAL OPERATIONS IN AN UNCONVENTIONAL WARFARE ENVIRONMENT**

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This thesis researches the intricacies of the art of influence in an unconventional warfare environment to develop a model of influence that can be utilized by Special Forces conducting unconventional warfare. The research is based on several premises: 1) the strategic utility of Special Forces (SF) lies in its ability to influence a target audience in an unconventional warfare (UW) environment, and 2) the nature of UW necessitates a bottom up and non-kinetic approach to influence in order to have lasting effective results.

Chapter II focuses on the elements of influence derived from the academic literature and from commercial and political applications of cognitive and social psychology. Chapter III examines key elements of influence derived from the Huk Rebellion in the Philippines and the Malayan Emergency. Chapter IV reviews several relevant models and uses them, along with the analysis of the key elements of influence identified in prior chapters, to develop a new grassroots influence model.

**KEYWORDS:** Special Forces, Psychological Operations, Unconventional Warfare, Art of Influence

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# DEFENSE ANALYSIS

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## IMPROVING COUNTERINSURGENCY: AN AUXILIARY TRAINING PROGRAM FOR SPECIAL FORCES

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The U.S. military has proven its strength many times over through its ability to dominate opponents on the conventional battlefield. However, when it comes to irregular wars and insurgent conflicts, which are defined by enemies who conduct war from the shadows and refuse to meet on the open field, finding success has been far more difficult. The nature and dynamics of these unconventional wars are dramatically different from the conventional warfare realm, and require innovative approaches and the rethinking of many long-held conceptions of waging war.

Conducting unconventional warfare has been the core mission of U.S. Army Special Forces (USSF) since it was founded in 1952. Throughout a relatively short history, USSF have shown a broad utility in conducting operations with indigenous military, paramilitary, and civilian personnel in "irregular wars" and low intensity conflicts (LICs), and thus Special Forces have been widely regarded as the preeminent experts in this particular field of warfare. Now more than ever, the capabilities of Special Forces are invaluable in supporting U.S. national security strategy, continuing the Global War on Terror (GWOT), and supporting efforts to transform military capabilities towards irregular warfare and unconventional conflicts. USSF are now faced with a difficult challenge: high demand and operations tempo require that USSF must find new ways to more effectively and efficiently employ their skills in unconventional environments.

In order to enhance the capabilities of USSF in conducting unconventional warfare and counterinsurgency, this thesis proposes that USSF develop a training program that allows recruitment and selection of both indigenous personnel and U.S. foreign-born as auxiliaries and surrogates to USSF operations. Training would take place in the U.S. and would be for the explicit purpose of creating indigenous cadres for assisting Special Forces Operational Detachment Alphas (SFODAs) in developing operational/security forces and intelligence networks at the local level in order to create long-term stability in unconventional conflict areas.

**KEYWORDS:** Insurgency, Counterinsurgency, Unconventional Warfare, COIN, Indigenous Forces, Auxiliaries, Constabulary Force, U.S. National Security Strategy, Military Strategy, GWOT, Special Forces, SF, USSF

# MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

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## **ELECTRONIC INTELLIGENCE (ELINT) SIGNAL PROCESSING ON RECONFIGURABLE COMPUTERS FOR DETECTION AND CLASSIFICATION OF LOW PROBABILITY OF INTERCEPT (LPI) EMITTERS**

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This thesis describes the implementation of an Electronic Intelligence (ELINT) algorithm for the detection and classification of Low Probability of Intercept (LPI) signals. The algorithm is coded in the C programming language and executed on a Field Programmable Gate Array-based reconfigurable computer; the SRC-6 manufactured by SRC Computers, Inc. Specifically, this thesis focuses on the preprocessing stage of an LPI signal processing algorithm. This stage receives a detected signal that has been run through a Quadrature Mirror Filter Bank and outputs the preprocessed signal for classification by a neural network. The results show that these three steps running in parallel on the reconfigurable computer cause significant benefits in cost and speed. A major value of this study comes from comparing the performance of the reconfigurable computer to that of supercomputers and embedded systems that are currently used to solve the signal processing needs of the United States Navy.

**KEYWORDS:** LPI Emitters, ELINT Algorithms, Quadrature Mirror Filter Bank, Field Programmable Gate Arrays, Reconfigurable Computers

## **FINGERPRINT RECOGNITION**

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The use of biometrics is an evolving component in today's society. Fingerprint recognition continues to be one of the most widely used biometric systems. This thesis explores the various steps present in a fingerprint recognition system. The study develops a working algorithm to extract fingerprint minutiae from an input fingerprint image. This stage incorporates a variety of image pre-processing steps necessary for accurate minutiae extraction and includes two different methods of ridge thinning. Next, it implements a procedure for matching sets of minutiae data. This process goes through all possible alignments of the datasets and returns the matching score for the best possible alignment. Finally, it conducts a series of matching experiments to compare the performance of the two different thinning methods considered. Results show that thinning by the central line method produces better False Non-match Rates and False Match Rates than those obtained through thinning by the block filter method.

**KEYWORDS:** Biometrics, Fingerprint, Minutiae, Thinning, Matching

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# ELECTRICAL ENGINEERING

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## **SIMULATION AND PERFORMANCE OF A HIGH FREQUENCY CYCLOCONVERTER**

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With modern naval vessels headed in the direction of integrated power systems, new attention must be paid to efficiency of both power and space. However, modern designs for ship power systems often incorporate DC link converters, or synchroconverters, into their design. Not only does this add extra steps into the power conversion process, it also adds the DC link, which requires large capacitors and can aggravate problems experienced in a short circuit. Modern research for cycloconverters is showing that they have many advantages over the synchroconverter when used in a ship power system.

However, cycloconverters also have downsides. One of these problems is the incorporation of harmonics into the supply current, distorting the generator output, as well as voltage harmonics at the output of the converter, which can cause problems at the various loads. Most disastrous of all, additions of subharmonics, or interharmonics which occur below the fundamental, can appear. Subharmonics are nearly unfilterable and they can cause serious problems for any power system. This study specifically considers higher frequency inputs to see if these subharmonics can be mitigated in a cycloconverter system.

**KEYWORDS:** Integrated Power Systems, Cycloconverter, Synchroconverter, DC Link, Subharmonics, Interharmonics

## **GROUND-BASED HIGH-ENERGY POWER BEAMING IN SUPPORT OF SPACECRAFT POWER REQUIREMENTS**

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This thesis investigates the feasibility of projecting ground-based laser power to energize a spacecraft electrical bus via the solar panels. The energy is projected through a telescope, using modern optical compensation systems, at controlled wavelengths. Research conducted on high-energy lasers has matured to the point that today, the bulk of the power required by spacecraft on orbit can be projected from the surface of the earth. With battery life being the greatest limitation on spacecraft lifespan, the ability to provide electrical power from the surface to a satellite in eclipse with degraded batteries could mean multi-billion dollar cost savings by extending the lifetime of current and future satellites.

**KEYWORDS:** Directed Energy, Power Beaming, Space-Craft Power, Solar-Cell Technology, Laser Technology, Free Electron Laser, Solid State Laser, Chemical Laser, NPSAT 1, Band Gap, Optics, Radiation Damage, Telescopes with Adaptive Optics, Orbital Mechanics, Annealing, Military Laser Hardware

## **SIGNAL-TO-NOISE RATIO GAINS AND SYNCHRONIZATION REQUIREMENTS OF A DISTRIBUTED RADAR NETWORK**

**Sean M. Hurley-Captain, United States Marine Corps**

**B.S., United States Naval Academy, 2000**

**Master of Science in Electrical Engineering-June 2006**

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

**Phillip E. Pace, Department of Electrical and Computer Engineering**

This thesis explores the benefits of two, three, and four-node distributed radar networks with the potential to provide a received Signal-to-Noise Ratio (SNR) proportional to  $n^2$  times that of a single-node system,

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where  $n$  is the number of nodes in the network. By plotting the Cassini curves for these distributed radar networks along with the Cassini curves of a monostatic radar system for the same level of received SNR, these benefits are graphically demonstrated. The SNR gains result in a much larger area of coverage for the distributed radar network compared to that of a power-equivalent monostatic radar. The impact of phase and pulse synchronization on a distributed radar network is also explored. By examining phase error and pulse error separately, and then examining their impact on the coverage areas of a two-node distributed radar network, the importance of synchronization to a distributed radar network is demonstrated.

**KEYWORDS:** Distributed Sensor Network, Distributed Radar, System of Systems, Sensor Network, Target Tracking, Signal-to-Noise Ratio, Synchronization, Cassini Ovals, Cassini Curves, Area of Coverage

## **FIELD PROGRAMMABLE GATE ARRAY HYSTERESIS CONTROL OF PARALLEL CONNECTED INVERTERS**

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B.S., Brigham Young University, 1989**

**Master of Science in Electrical Engineering-June 2006**

**Advisor: Robert W. Ashton, Department of Electrical and Computer Engineering  
Second Reader: Xiaoping Yun, Department of Electrical and Computer Engineering**

This thesis presents the use of a field programmable gate array (FPGA) to control two commercial, off-the-shelf (COTS) power electronic building blocks (PEBB) configured to produce a three-phase low distortion sine wave output. The next generation warship is expected to contain more electric loads that require quality variable frequency output. A typical propulsion motor in the 40MW range will probably require the current Total Harmonic Distortion (THD) to be less than 3% (MIL-STD-1399). However, high power low distortion inverters usually have associated high cost and weight penalties. This thesis presents a parallel hybrid converter that demonstrates the use of a high power low fidelity bulk inverter with a low power high fidelity active filter. The high power low fidelity output is sourced using a six-step inverter which produces the entire fundamental current. The low power hysteresis controlled active filter section produces only cancelling harmonic current. The paralleled result is a pristine output sine wave with a 1% current THD. This solution should offer the Navy a high fidelity high power inverter without cost and weight penalties. Schematics and code are included as appendices.

**KEYWORDS:** Field Programmable Gate Array, FPGA, Hysteresis Control, Inverter, Parallel Inverters, Load Sharing, Active Filter, DC-AC Inverter, Current-Source Inverter, Hybrid Inverter

## **DEVELOPMENT OF ALGAN/GALLIUM NITRIDE (GAN) HIGH-ELECTRON MOBILITY TRANSISTORS (HEMTS) ON DIAMOND SUBSTRATES**

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**Master of Science in Electrical Engineering-June 2006**

**Advisor: Todd R. Weatherford, Department of Electrical and Computer Engineering  
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Silicon-based semiconductor devices are rapidly approaching the theoretical limit of operation and are becoming unsuitable for future military requirements. The scope of semiconductor devices has been expanded by wide bandgap devices, such as gallium nitride (GaN), to include the possibility for high power and high frequency operation. A new generation of high speed – high frequency devices is required to meet current and future military needs. The Gallium Nitride High Electron Mobility Transistor (HEMT) is showing great promise as the enabling technology in the development of military radar systems, electronic surveillance systems, communications systems, and high voltage power systems. Typically, sapphire or silicon carbide is utilized as the substrate material in most HEMT designs. This thesis explores the possibility of utilizing a diamond substrate to increase the power handling capability of the AlGaN/GaN HEMT. Diamond offers increased thermal property parameters that can be simulated in the commercially available Silvaco software package. A complete electrical and thermal analysis of the model is conducted and compared to actual device characteristics. The results of the software simulation and measurements on

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the test devices indicate that diamond substrates will enable the HEMT to be operated at a higher power than traditional sapphire substrate HEMTs.

**KEYWORDS:** High Electron Mobility Transistor, HEMT, Gallium Nitride, Heterostructure, Sapphire Substrate, Diamond Substrate, Silvaco, ATLAS, BLAZE, GIGA

## **A SYSTEMATIC APPROACH TO DESIGN OF SPACE-TIME BLOCK CODED MULTIPLE-INPUT MULTIPLE OUTPUT (MIMO) SYSTEM**

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**B.S., Chung-Cheng Institute of Technology, 2001**

**Master of Science in Electrical Engineering-June 2006**

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

This thesis studies the performance of Multiple-Input Multiple Output (MIMO) systems that use Space-Time Block Coding (STBC). Such systems can be employed to improve the bit error rate (BER) performance of wireless communication systems and to counter the detrimental effects of channel fading and other distortion phenomena. A systematic method is proposed for designing a space-time orthogonal MIMO scheme that employs an arbitrary number of transmitting and receiving antennas, and (through simulation) the performance improvements that can be attained by employing this design approach are evaluated. A general formula is presented for determining the rate (i.e., the ratio of the number of symbols transmitted to the number of symbol intervals required) of systems that employ this design. Additionally, this thesis analyzes the relationship between channel correlation and antenna spacing for the case of MIMO systems that use a linear antenna configuration, and, through simulation studies, it is shown how such systems can take the advantage of the multipath phenomenon to reduce the detrimental effects of channel correlation.

**KEYWORDS:** Multiple-Input Multiple-Output, MIMO, Orthogonal Design, Space-Time Block Coding, STBC, Stanford University Interim Models, SUI Models, Spatially Correlated MIMO Channels, Spatial Diversity, Alamouti Scheme, Correlation Coefficient

## **USE OF AN ACOUSTIC NETWORK AS AN UNDERWATER POSITIONING SYSTEM**

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**B.S., Case Western Reserve University, 1995**

**Master of Science in Electrical Engineering-June 2006**

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

Underwater acoustic networks provide an interface between unmanned undersea vehicles (UUV) and surface or land-based control systems. By exploiting range data measured incidental to communications on these networks, it is possible to perform underwater positioning similar to that of the satellite-based global positioning system (GPS) program. In this thesis, several algorithms for generating position fixes from these range data are implemented, tested, and evaluated with synthetic data. The algorithms are then applied to data obtained during operations at sea.

**KEYWORDS:** Acoustic, Ranging, Seaweb, Undersea Warfare, Navigation, Submarine, UUV, AUV

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## **NEGATIVE-BIAS TEMPERATURE INSTABILITY (NBTI) EXPERIMENT**

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The phenomenon known as negative bias temperature instability (NBTI) impacts the operational characteristics of complementary metal oxide semiconductor (CMOS) devices, and tends to have a stronger effect on p-channel devices. This instability is observed with an applied “on” biasing during normal operation and can be accelerated with thermal stress. A normal applied electrical bias on CMOS transistors can lead to the generation of interface states at the junction of the gate oxide and the transistor channel. The hydrogen that normally passivates the interface states can diffuse away from the interface. As a result, the threshold voltage and transconductance will change. These interface states can be measured to determine the susceptibility to NBTI of the devices. For this purpose, a charge pumping experiment and other On-the-Fly techniques at certain temperatures can provide the interface state density and other valuable data. NBTI can impact current technological fabrication processes, such as those provided to the government from IBM. This paper explains this testing of current submicron transistor technology, which will be used for military applications.

**KEYWORDS:** NBTI, On-the-Fly, Semiconductor Reliability, IBM Trusted Foundry Program, 130nm, Military Electronics

## **SOURCE LOCALIZATION USING WIRELESS-SENSOR NETWORKS**

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**John McEachen, Department of Electrical and Computer Engineering**

Wireless sensors can be worn on soldiers or installed on vehicles to form distributed sensor networks to locate the source of sniper fire. A two-step source localization process is proposed for this sniper detection task. The time difference of arrival (TDOA) for the acoustic signals received by the sensors is first estimated using the generalized cross-correlation (GCC) method. The estimated TDOA values are then used by the hybrid spherical interpolation/maximum likelihood (SI/ML) estimation method to estimate the shooter location. A simulation model is developed in MATLAB to study the performance of the hybrid SI/ML estimation method. A wireless sensor network is simulated in NS-2 to study the network throughput, delay, and jitter. Simulation results indicate that estimation accuracy can be increased by increasing the number of sensors or the inter-sensor spacing. The constraint of small inter-sensor spacing on wearable sensors is found to degrade the estimation accuracy, but vehicular configuration providing larger inter-sensor spacing can help improve the estimation accuracy. The sensor topology should be well represented in all three dimensions to obtain desired estimation accuracy. The estimation accuracy is not adversely affected by sensor node failures or location perturbations. The NS-2 simulation results indicate that the wireless sensor network has low delay and can support fast information exchange needed in counter-sniper applications.

**KEYWORDS:** Wireless Sensor Networks, Source Localization, Sniper Detection, Counter-Sniper

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## PERFORMANCE ANALYSIS OF THE IEEE 802.11G WAVEFORM TRANSMITTED OVER A FADING CHANNEL WITH PULSE-NOISE INTERFERENCE

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**Master of Science in Systems Engineering-June 2006**

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**David Jenn, Department of Electrical and Computer Engineering**

The performance of the most promising wireless local area network (WLAN) standards today, IEEE 802.11g, which specifies orthogonal frequency-division multiplexing (OFDM) in order to avoid multi-path effects and at the same time achieve high data rates, is examined in this thesis. Four different receivers are investigated and their performance is analyzed with Viterbi soft decision decoding when the signal is transmitted over a slow, flat fading Nakagami channel for additive white Gaussian noise (AWGN) only, as well as for AWGN plus pulse-noise interference (PNI). The implementation of forward error correction (FEC) coding with soft decision decoding (SDD) improves the performance compared to uncoded signal if pulse-noise interference is not present. The scenarios when no side information is available (linear-combining receiver), when perfect side information is available (noise-normalizing receiver), and two alternatives to the noise-normalized receiver with much coarser side information (modified noise-normalized receiver and noise-normalized receiver with normalization error) are examined. All the scenarios are examined for various fading and interference conditions. The performance of the noise-normalized receiver is, as expected, much improved compared to the linear-combining receiver when PNI is present. Finally, the noise-normalized receiver with normalization error achieves the same or better performance than the noise-normalized receiver without the exact interference noise power.

**KEYWORDS:** Nakagami Fading Channel, Pulse-Noise Interference, Interference Mitigation, Convolutional Coding

## SECURITY OF SENSOR NETWORKS

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

This thesis discusses the security of sensor networks. First, an overview of the security architectures of two dominant implementations of sensor networks in the market today is presented: the TinyOS stack and the IEEE 802.15.4 stack. Their similarities and differences are explored and their strengths and limitations are discussed. Where applicable, comparisons are made with IEEE 802.11 wireless local area network (LAN) to highlight improvements and lessons learned. It is pointed out that in general, IEEE 802.15.4 offers better security, but replay protection is effectively missing in today's implementations and access control is poorly implemented. Consequently, TinyOS is still the better option for devices with severe resource constraints. Finally, as a tool to aid in the security analysis of sensor network, the design and implementation of a TinyOS sniffer is presented and captured frames for a simple sensor network application are analyzed for the purpose of validation.

**KEYWORDS:** Sensor Network, Security, TinyOS, Zigbee, IEEE 802.15.4

# MASTER OF SCIENCE IN INFORMATION OPERATIONS

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## INFORMATION OPERATIONS DURING THE MALAYAN EMERGENCY

**James R. Bortree-Lieutenant Colonel, United States Air Force  
B.S., Campbell University, 1991**

**Master of Science in Information Operations-June 2006**

**Advisor: Hy S. Rothstein, Department of Defense Analysis**

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

Today, information operations (IO) is an area of emerging importance in military science. IO, however, is not new. Many of the elements of IO have existed for hundreds, and in the case of specific elements like military deception (MILDEC), for thousands of years. IO becomes more important in dealing with the conflicts faced today, particularly as modern wars transition away from the large force-on-force encounters of the past. This thesis focuses on the specific British IO lessons learned during the Malayan emergency. The thesis also examines the IO implications of British organizational and cultural adaptation to counter the insurgents. Finally, it examines the most recent list of relevant Joint Doctrine, which drives how the individual services train, equip, and resource forces for counter insurgency.

**KEYWORDS:** Malaya, Insurgency, Joint Doctrine, Information Operations, PSYOP, OPSEC, MILDEC, EW



# MASTER OF SCIENCE IN INFORMATION SYSTEMS AND OPERATIONS

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## THE PERFORMANCE AND COMPATIBILITY OF THIN-CLIENT COMPUTING WITH FLEET OPERATIONS

**Kenneth J. Landry, Jr.-Lieutenant, United States Navy  
B.S., Oregon State University, 2000**

**Master of Science in Information Systems and Operations-June 2006  
Advisor: Douglas E. Brinkley, Graduate School of Business and Public Policy  
Second Reader: Anthony Kendall, Department of Information Sciences**

This research explores the feasibility of replacing traditional networked desktop personal computers (PC) with a thin client/server-based computing (TCSBC) architecture. After becoming nearly extinct in the early 1990s, thin clients are emerging on the forefront of technology with numerous bandwidth improvements and cost reduction benefits.

The results show that TCSBC could provide a practical and financially sound solution in meeting the Navy's need to reduce costs and propagate the latest technology to all personnel. This solution may not meet the requirements of all Naval commands. A thorough performance analysis should be conducted of the applications employed and the overall expenditures prior to implementation.

**KEYWORDS:** Thin Client, Thin Client/Server-Based Computing, Total Cost of Ownership, Windows Based Terminals, Wyse, Expansion

## BLUFFING WITH A PAIR OF DEUCES: THE DOWNSIDE OF SUCCESSFUL DECEPTION

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**Master of Science in Information Systems and Operations-June 2006  
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Second Reader: John Arquilla, Department of Defense Analysis**

This thesis examines two examples of strategic deception campaigns - interwar Germany and modern Iraq - to determine the necessity for a clear framework and to decide how deception campaigns might meet overall national strategic goals. With the mindset of a pending overhaul in the manner in which the Department of Defense conducts business, understanding the importance of deception will become increasingly vital as the military becomes lighter and leaner. With such a change in the makeup of the force, old conventions of warfare, requiring a numerical advantage, may have to be forsaken in favor of techniques traditionally considered unconventional. By developing such a doctrine now, the challenge can be met before it actually arises. The key to doing so is examining past successes and failures and learning from history's mistakes. Using the DoD framework as a basis, it is possible to use the analysis of these case studies to develop a planning method to mitigate many of the hurdles experienced in these campaigns, from planning and execution to termination.

**KEYWORDS:** Deception, Iraq, Germany, Weapons of Mass Destruction, Rearmament, Weapons Programs



# **MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT**

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## **AN ANALYSIS OF MANAGEMENT TECHNIQUES AND THEIR IMPACT ON THE MARINE CORPS IN A NAVY MARINE CORPS INTRANET ENVIRONMENT**

**Charles B. Buckley-Captain, United States Marine Corps  
B.S., Athens State University, 1998**

**Master of Science in Information Technology Management-June 2006**

**Advisor: Glenn R. Cook, Department of Information Sciences**

**Second Reader: Thomas J. Housel, Department of Information Sciences**

The movement towards a network centric environment is changing the requirements for network management. The ability to quickly adapt to changing conditions is crucial to the success of joint forces; information technology (IT) systems are critical enablers of that flexibility. The challenge facing managers today is to provide robust, integrated, secure, and interoperable information systems and networks; a challenge that has never been more demanding than it is today. As the components of the Department of Defense continue their transformation efforts, it is important to look to successful organizations for management techniques to aid in providing effective and efficient IT services. This thesis explores current management trends such as outsourcing, the Information Technology Infrastructure Library (ITIL), Real Options, Business Process Reengineering (BPR), and Knowledge Value Added (KVA), to determine their possible impact on the manner in which the DoD manages its IT services.

**KEYWORDS:** Navy Marine Corps Intranet, NMCI, Seat Management, Outsourcing, Knowledge Value Added, KVA, Return on Knowledge, ROK, Business Process Redesign, BPR, Knowledge Management, Information Technology Infrastructure Library, ITIL, Real Options, Marine Corps Enterprise Network, MCEN, U.S. Marine Corps, Enterprise Architecture

## **USABLE KNOWLEDGE GAINED OR REFINED FOR PERSONNEL SERVING IN THE OPERATING FORCES THROUGH NAVAL POSTGRADUATE SCHOOL'S DISTRIBUTED LEARNING PROGRAM**

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**Master of Science in Information Technology Management-June 2006**

**Advisor: Thomas J. Housel, Department of Information Sciences**

**Second Reader: Steven J. Iatrou, Department of Information Sciences**

This research examines the usable knowledge gained or refined through Distributed Learning from the Naval Postgraduate School for personnel serving in operational billets. The population studied is students currently enrolled or students that had completed the Information Systems and Operations certificate program. The study uses a web-based survey for data collection and uses that data to answer four research questions. The data clearly demonstrate that Distributed Learning is equivalent to resident coursework in terms of usable knowledge gained or refined, and that such usable knowledge is distributed quickly and efficiently to individual service members. Beyond the individual, a direct transfer to the organization of a portion of the knowledge gained or refined occurs. The data suggest that frequency of use of skills can be used as a measure of effectiveness for the Distributed Learning program at the Naval Postgraduate School, but more data are needed to be conclusive. Additionally, the results provide evidence that Distributed Learning provides a strong, social interaction learning context. This evidence challenges the assertion that social interaction between students and faculty is primarily a characteristic of resident coursework and a limitation of Distributed Learning.

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**KEYWORDS:** Distributed Learning, Distance Learning, Graduate Education, Graduate Skills, Naval Postgraduate School, NPS, Information Technology Management, Graduate Certificate, Frequency of Use, Knowledge Gained or Refined, Skills Gained or Refined, Knowledge Value Analysis

### DEVELOPMENT OF FUTURE COURSE CONTENT REQUIREMENTS SUPPORTING THE DEPARTMENT OF DEFENSE'S INTERNET PROTOCOL VERSION 6 TRANSITION AND IMPLEMENTATION

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**Master of Science in Information Technology Management-June 2006**

**Advisors: Geoffrey Xie, Department of Computer Science**

**John Gibson, Department of Computer Science**

**Second Reader: Kristen Tsolis, Department of Defense Analysis**

This thesis focuses on academia, specifically the Naval Postgraduate School and its requirement to implement an education program that allows facilitators to properly inform future students of the gradual implementation of Internet Protocol version 6 (IPv6) technology while phasing out Internet Protocol version 4 (IPv4) from the current curriculum as the transition to IPv6 progresses. The Department of Defense's current goal is to complete the transition of all DoD networks from IPv4 to IPv6 by fiscal year 2008. With this deadline quickly approaching, it is imperative that a plan to educate military and DoD personnel be implemented in the very near future. The goal of this thesis is to research and suggest a program that facilitators can use that will show the similarities, changes, advantages, and challenges that exist for the transition.

**KEYWORDS:** IPv6 Transition, IPv6 Education, NPS Curriculum, Next Generation Network, IPv4 to IPv6

### EXPERIMENTATION IN A COLLABORATIVE PLANNING ENVIRONMENT

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**Master of Science in Information Technology Management-June 2006**

**Diane M. Smith-DoD Civilian**

**B.S., California State University-Monterey Bay, 2004**

**Master of Science in Information Technology Management-June 2006**

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**Shelley P. Gallup, Department of Information Sciences**

This research details the Oracle Database and Collaboration software technologies, the Trident Warrior (TW) planning and experimentation process, and how the utilization of those software technologies, coupled with the Knowledge Management (KM) methodologies, affect large-scale military experimentation processes. Of specific focus is how the FORCEnet Innovation and Research Enterprise (FIRE) system at the Naval Postgraduate School has facilitated rapid advancement of TW scope and capabilities, as well as delivered a significantly improved final product to Network Warfare Command (NETWARCOM).

**KEYWORDS:** Collaboration, Enterprise System, Military Experimentation, FORCEnet, FIRE

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# INFORMATION TECHNOLOGY MANAGEMENT

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## DEPLOYMENT OF 802.15.4 SENSOR NETWORKS FOR COMMAND, CONTROL, COMPUTER, AND COMMUNICATIONS FOR INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (C4ISR) OPERATIONS

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Master of Science in Information Technology Management-June 2006

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Second Reader: Rex Buddenberg, Department of Information Sciences

The applications of wireless sensor networks (WSNs) have risen in recent years in both civilian and military sectors. While a number of WSN-based systems have been proposed and developed, vast majority of them focus on capability demonstration rather than the issues of deployment. As a result, even though the systems can serve useful purposes, they are very hard to deploy. The objective of this thesis is to focus on the deployment issues of WSNs. In addition, this thesis assesses the optimal configurations and environments that enable the sensor networks to thrive in a Command, Control, Computer, and Communications for Intelligence, Surveillance, and Reconnaissance (C4ISR) environment.

This thesis presents a technology review of the ZigBee and the IEEE 802.15.4 standards that form the core technology in WSNs. The thesis also discusses the IEEE 802.15.4 Physical and Media Access Control Layers that comprise the bottom two layers of WSNs.

This thesis also provides a brief introduction to the hardware and software that deal with WSN technology. Lastly, this thesis evaluates the military applications of WSNs. It is hoped that the military can employ wireless sensors to increase situational awareness, attain information superiority, and improve decision-making.

**KEYWORDS:** Wireless Sensor Networks, ZigBee, Deployment Issues, Crossbow Motes, Sensor Nodes

## AN ANALYSIS OF CHINA'S INFORMATION TECHNOLOGY STRATEGIES AND THEIR IMPLICATION FOR U.S. NATIONAL SECURITY

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Master of Science in Information Technology Management-June 2006

Advisor: LtCol Karl D. Pfeiffer, USAF, Department of Information Sciences

Second Reader: Glenn R. Cook, Department of Information Sciences

In the past decades, China's military modernization and fast economic development have increasingly attracted international attention, especially from the United States. In addition, the People's Liberation Army (PLA) has begun to study the revolution in military affairs (RMA) by focusing on asymmetric warfare capabilities under high-tech conditions. China definitely believes that asymmetric warfare operations have the advantage of creating a smarter attack style of avoiding direct confrontation with the powerful military strength of the U.S. In summary, the PLA considers asymmetric warfare operations to be a type of warfare that combines both the thinking of China's classic military strategist Sun Tzu ("using the inferior to defeat the superior") and the demand of modern information technology, such as Information Warfare (IW) applications.

In the face of China's development of asymmetric warfare capabilities, the United States must think deeply about how to deal with the threat from China's asymmetric warfare operations, which is gradually becoming the superpower in the world.

**KEYWORDS:** United States, People's Republic of China, Republic of China, Taiwan, Taiwan Strait, PLA, Military Moderation, Information Warfare, Asymmetric Warfare

# INFORMATION TECHNOLOGY MANAGEMENT

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## ASSESSING THE OPERATIONAL VALUE OF SITUATIONAL AWARENESS FOR AEGIS AND SHIP SELF DEFENSE SYSTEM (SSDS) PLATFORMS THROUGH THE APPLICATION OF THE KNOWLEDGE VALUE ADDED (KVA) METHODOLOGY

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Master of Science in Information Technology Management-June 2006

Advisor: Thomas J. Housel, Department of Information Sciences

Second Reader: Glenn R. Cook, Department of Information Sciences

As the United States Navy strives to attain a myriad of situational awareness systems that can provide the functionality and interoperability required for future missions, the fundamental idea of open architecture is beginning to promulgate throughout the Department. In order to make rational, informed decisions concerning the processes and systems that will be integrated to provide this situational awareness, an analytical method must be used to identify process deficiencies and produce quantifiable measurement indicators.

This thesis applies the Knowledge Value Added methodology to the current processes involved in track management aboard AEGIS and Ship Self Defense System (SSDS) platforms. Additional analysis is conducted based on notional changes that could occur were the systems designed using an open architecture approach. A valuation based on knowledge assets is presented in order to provide a comparative analysis detailing how knowledge assets can be leveraged in the most efficient and effective manner.

**KEYWORDS:** Information Systems Technology, Track Management, Situational Awareness, Knowledge Value Added, Return on Knowledge, Knowledge Assets, Open Architecture, Combat Identification, Metrics

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

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## **CHARACTERISTICS AND TREND OF ATTRITION FROM THE UNITED STATES NAVAL ACADEMY**

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**Master of Science in Leadership and Human Resource Development-June 2006**

**Advisors: Janice H. Laurence, Office of the Secretary of Defense  
Linda Mallory, United States Naval Academy**

The purpose of this research is to examine and describe attrition and to analyze factors that affect attrition at the United States Naval Academy. Specifically, the research attempts to identify characteristics that may signal a student's propensity to attrite from school. The intention is to determine if there are common characteristics among those who attrite from the Academy and to determine what role organizational factors and Academy experiences have on attrition. The desired end state is to identify a partial list of characteristics the Company Officer may use to flag at-risk midshipmen and, when appropriate, intervene to reduce attrition. This research examines attrition for six graduating cohorts, the classes of 2000 – 2005 (N = 6905), and is conducted in three steps. First, trends and consistencies among the graduating cohorts are identified. This macro view of attrition gives the reader an overall feel for how attrition affects the different year groups. Next, relationships between factors identified through the literature and attrition are analyzed using chi-square tests. Finally, those factors identified as having a significant effect on attrition are used in a hierarchical logistical regression. The results of the regression indicate that those who fail one or more physical readiness tests, females, and minorities have a greater probability of attriting from the academy. This study summarizes the results and provides recommendations to the United States Naval Academy for future research.

**KEYWORDS:** Attrition, United States Naval Academy

## **AN ASSESSMENT OF ALCOHOL ABUSE BY MIDSHIPMEN AT THE UNITED STATES NAVAL ACADEMY**

**Lydia J. Doye-Lieutenant, United States Navy  
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**Master of Science in Leadership and Human Resource Development-June 2006**

**Advisor: Brad Johnson, United States Naval Academy  
Second Reader: Linda Mallory, United States Naval Academy**

This thesis utilizes a multi-method approach to conduct exploratory research regarding the use and abuse of alcohol by midshipmen at the United States Naval Academy (USNA). Quantitative data are analyzed regarding midshipmen perceptions of abuse. Over 50% of midshipmen consider alcohol abuse a problem at the academy. Focus groups are conducted in order to gather qualitative data concerning Midshipmen drinking behaviors. Midshipmen representing all four classes at USNA report significant pressures not only to drink underage, but to binge drink. The probability of binge drinking at USNA may be related to the fact that midshipmen are restricted in their use of alcohol; there exists an attitude that they need to make up for lost time by over-indulging when they do have the opportunity. Sixty-five percent of the female and 77% of the male midshipmen participants admitted binge drinking within the last six months (significantly higher than the national college average of 44%). Fear of jeopardizing future careers prevents midshipmen from getting the medical assistance they need for alcohol poisoning or concerns about alcohol dependency. Recommendations include "playing down" the novelty of drinking, providing more opportunities for responsible use, establishing alternate avenues for reporting midshipmen for medical

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## **LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT**

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help, holding the 1/c midshipmen accountable for modeling responsible alcohol use, and continuing to support prevention education.

**KEYWORDS:** Alcohol Abuse, Binge Drinking, Underage Drinking, Midshipmen, United States Naval Academy

### **A VALIDITY REVIEW OF THE COLOR-COMPANY COMPETITION AT THE UNITED STATES NAVAL ACADEMY**

**Derek S. Dryden-Lieutenant, United States Navy  
B.S., United States Naval Academy, 2000**

**Master of Science in Leadership and Human Resource Development-June 2006**

**Advisor: Armando X. Estrada, Washington State University**

**Second Reader: Kurtis Swope, United States Naval Academy**

As the primary source of officers for the Navy and Marine Corps team, the Naval Academy's reputation is marked by the quality of its graduates. At the United States Naval Academy, the Color Company Competition annually honors the highest performing company within the Brigade of Midshipmen. This competition includes measures of academic, athletic, and professional measures of performance.

Using data obtained through the Institutional Research Department, the Physical Education Department, and the Activities and Operations Offices, this study examines the validity of the current performance measurement tool at the academy. Through the use of linear regression models, this study finds that the current procedures do meet the intent of published guidance, but that those procedures require revision and updating.

Conclusions and recommendations for future improvement are provided at the completion of the study. Included as a recommendation is a proposed program combining both the Color Company Competition and the Company Incentive Program. This program and other initiatives are intended to intensify the Naval academy's focus on fostering esprit de corps and improving the development of midshipmen.

**KEYWORDS:** Performance Measurement, Motivation, Incentive Program, Program Analysis, U.S. Naval Academy, Color Company Competition, Team Performance

### **SELECTION OF NAVAL-ACADEMY GRADUATES FOR NUCLEAR TRAINING**

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**Master of Science in Leadership and Human Resource Development-June 2006**

**Advisors: Armando X. Estrada, Washington State University**

**Matthew A. Carr, United States Naval Academy**

This study examines some of the criteria used in selecting Naval Academy graduates for entry into the Navy's nuclear power program. Data from 1,096 Naval Academy graduates who attended Nuclear Power School (NPS) between 1997 and 2003 is analyzed using hierarchical linear regressions. Two models are used in the study. In the first model, the independent variables are major type, service community assigned, and order of merit (class rank). In the second model the independent variables are major type, service community assigned, cumulative academic quality point rating (CAQPR), technical quality point rating (TQPR), and military quality point rating (MQPR). The dependent variable in both models is Nuclear Power School grade point average (GPA). The study finds that the more engineering-based an officer's major was at the academy, the better he performed at NPS. It also finds that officers assigned to the surface warfare-nuclear community perform slightly better than those assigned to the submarine community. Lastly, the strongest predictor examined is the variable that measures general cognitive ability. Order of merit and CAQPR are the strongest predictors of NPS GPA in their respective models. TQPR is a weak predictor of NPS GPA and MQPR is negatively related to performance at NPS.

**KEYWORDS:** General Cognitive Ability, Nuclear Power Training, Academic Performance

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# LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

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## THE IMPACT OF RELIGIOSITY ON MIDSHIPMAN ADJUSTMENT AND FEELINGS OF ACCEPTANCE

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**Master of Science in Leadership and Human Resource Development-June 2006**

**Advisors: Janice H. Laurence, Office of the Secretary of Defense  
Gail F. Thomas, Graduate School of Business and Public Policy**

This qualitative study briefly explores whether belief in and practice of religion affects the overall adjustment and experience of midshipmen at the U.S. Naval Academy. This study examines religiosity in the U.S. military and at the U.S. Naval Academy in light of the recent investigation of religious intolerance at the U.S. Air Force Academy. Additionally, this thesis includes a qualitative assessment of data collected from focus groups of first and second-class midshipmen (seniors and juniors, respectively), observing current issues of tolerance, acceptance, diversity, and understanding between midshipmen with differing religious beliefs, and the in-group/out-group phenomenon that occurs between the religious majority and minority of the institution. Research into minority and diversity issues is compared to focus-group data about minority versus majority religious groups and beliefs. The contents include 1) a review of religions and religious practices at the U.S. Naval Academy, 2) a discussion of the data obtained from qualitative analysis of eight focus groups, and 3) how the focus group data portray the connection between religiosity and its impact on midshipman adjustment and acceptance. The data used are from actual midshipmen in the classes of 2006 and 2007.

**KEYWORDS:** Religion, Religiosity, Acceptance, Adjustment, Tolerance, Diversity

## WHO BECOMES A LIMITED-DUTY OFFICER AND CHIEF WARRANT OFFICER? AN EXAMINATION OF DIFFERENCES OF LIMITED-DUTY OFFICER AND CHIEF WARRANT OFFICERS IN THE NAVY

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**Master of Science in Leadership and Human Resource Development-June 2006**

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Cary Simon, Graduate School of Business and Public Policy**

This thesis examines the Navy limited-duty officer and chief warrant officer programs to determine the differences in characteristics of each program. Descriptive statistics and correlation analysis is developed for year groups 1990 through 2005 to analyze the differences in background characteristics and military characteristics of both programs. The study uses a logistic regression analysis to examine the predictors of background and military characteristics of limited-duty officers and chief warrant officers. The results of the study reveal that the background characteristics of age, education, race, and ethnicity are significantly different between the limited-duty officer and chief warrant officer communities. The military characteristics of rank, length of service, and Armed Forces Qualification Test are significant among limited-duty and chief warrant officers. This study explains the results and provides recommendations to the Bureau of Naval Personnel for future research.

**KEYWORDS:** United States Navy, Background Characteristics, Military Characteristics



# MASTER OF SCIENCE IN MECHANICAL ENGINEERING

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## STREAMWISE FLUCTUATIONS OF VORTEX BREAKDOWN AT HIGH REYNOLDS NUMBERS

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Master of Science in Mechanical Engineering-June 2006

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This thesis deals with the characterization of the dependence on the flow geometry of the streamwise fluctuations of the stagnation point of vortex breakdown in axisymmetric tubes and over delta wing aircraft. The statistical analysis presented herein shows that in an axisymmetric tube the “darting” about the mean stagnation point are distributed normally for the two Reynolds numbers:  $Re_D = 230,000$  and  $300,000$  (independently of the Reynolds number in the range noted). The darting over a delta wing is not only non-Gaussian but also exhibits rather large localized fluctuations (Strouhal numbers ranging from 0.04 to 0.1), presumably due to the strong influence of the surrounding flow and the geometrical conditions: increase of circulation along the trailing edge, the abrupt separation of flow at the base of the delta wing, and other protuberances that emerge from the upper and lower surfaces of the wing (support elements in laboratory and stabilizers on delta wing aircraft). It is concluded that the behavior of vortex breakdown is strongly dependent on the surrounding geometry, and that only experiments in axisymmetric tubes can provide the purest form of vortex breakdown for numerical simulations and analytical studies towards the understanding of the internal turbulence and its spectrum within the breakdown bubble for theoretical and industrial purposes.

**KEYWORDS:** Vortex Breakdown, Turbulence, Stagnation Point Fluctuation, Swirling Flow

## REACTIVE OBSTACLE AVOIDANCE FOR THE *REMUS* AUTONOMOUS UNDERWATER VEHICLE UTILIZING A FORWARD-LOOKING SONAR

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Second Reader: Douglas P. Horner, Department of Information Sciences

One day, fully autonomous autonomous underwater vehicles (AUVs) will no longer require human interactions to complete their missions. To make this a reality, the AUV must be able to safely navigate in unfamiliar environments with unknown obstacles. This thesis builds on previous work conducted at the Naval Postgraduate School’s Center for AUV Research to improve the autonomy of the *REMUS* class of AUVs with an implemented forward-looking sonar (FLS). The first part of this thesis deals with accurate path following with the use of look-ahead pitch calculations. With the use of a SIMULINK model, constraints surrounding obstacle avoidance path planning are then explored, focusing on optimal sensor orientation issues. Two path-planning methods are developed to address the issues of a limited sonar field of view and uncertainties brought on by an occlusion area. The first approach utilizes a pop-up maneuver to increase the field of view and minimize the occlusion area, while the second approach creates a path with the addition of a spline. Comparing the two methods, it is concluded that spline addition planner provides a robust optimal obstacle avoidance path and, along with the look-ahead pitch controller, completes the design of a “back-seat driver” to improve *REMUS*’s survivability in an unknown environment.

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**KEYWORDS:** *REMUS*, AUV, UUV, Autonomous Underwater Vehicle, Unmanned Underwater Vehicle, Reactive Obstacle Avoidance, Forward Looking Sonar, Vertical Plane, Pitch Controller, Spline, Gaussian, Occlusion, Optimal Sensor Orientation

### DESIGN OF COAXIAL SPLIT FLOW PULSE-DETONATION ENGINE

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**Master of Science in Mechanical Engineering-June 2006**

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**Second Reader: Christopher M. Brophy, Department of Mechanical and Astronautical Engineering**

Future Navy capabilities indicate the need for a supersonic cruise missile. Therefore, there exists a need for a low cost, lightweight, and efficient means of supersonic propulsion. The Naval Postgraduate School has been developing the Pulse Detonation Engine, which in theory has a thermodynamic efficiency greater than 50% as compared to 35% for state of the art constant-pressure cycles currently in use in gas turbines/ramjets/scramjets. Nonetheless, there are two major problems in the development of this engine: 1) the increase of the propulsive efficiency by removing the oxygen-assisted initiator currently in use, and 2) the reduction of internal total pressure losses caused by the highly constrictive internal flow-path geometry currently required to promote the deflagration to detonation transition (DDT). The aforementioned problems are addressed and a viable design is proposed through the implementation of a novel Transient Plasma Ignition system and novel split-flow path engine geometry as described in this work. Future work will concentrate on the development of a performance measurement test rig to experimentally assess the designs presented herein.

**KEYWORDS:** Pulse Detonation Engines, PDE, PDE Ignition, Transient Plasma Ignition, TPI, Coaxial Split Flow

### WIND TUNNEL RECONSTRUCTION, FLOW VERIFICATION, AND FLAPPING WING ANALYSIS

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**Master of Science in Mechanical Engineering-June 2006**

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

The Naval Postgraduate School's micro-air vehicle (MAV) wind tunnel is refurbished in this study. This wind tunnel has a 61 by 38 centimeter test section with a contraction ratio of 6.75, and testing speeds up to 9 meters per second (m/s). The objectives of this work are to create a high quality, customized facility for further MAV study, and to fully characterize the wake of the MAV at a plane downstream of the model. Extensive repairs are made to the wind tunnel intake, test section, and fan. The flow field produced in the tunnel is analyzed with hot wire anemometry. The turbulence intensity ranges from .7% to .5% for freestream velocities of 2 m/s to 5 m/s. The velocity variation across the test section ranges from .251% to .125%. A model of the NPS MAV is placed in the test section and the wake is studied with and without the main wing, and in vertical and horizontal orientations. The wake is characterized with hot wire anemometry and flow visualization techniques at various flapping frequencies and freestream velocities.

**KEYWORDS:** Low Speed Wind Tunnel, Low Reynolds Number, Constant Temperature Anemometry, Micro-Air Vehicle, Flapping Wing

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## **SIMULATION OF CYLINDER IMPLOSION INITIATED BY AN UNDERWATER EXPLOSION**

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The traditional study of underwater explosions (UNDEX) with respect to ship damage became of interest during World War II, when torpedo explosions near a ship created more damage than a direct hit. Following the war, many full-scale ship shock trials were conducted that provided much of the empirical data that is used in the field today. However, one type of shock phenomena became of interest in the late 1960s, which could be potentially more damaging than a typical underwater explosion; an implosion. Crude implosion experiments were conducted in the late 1960s. Although these experiments collected data on pressure waves, more emphasis was placed on the acoustical properties associated with an implosion event. Today, one of the Navy's concerns is about the potential for the implosion of a pressure vessel in close proximity to a submarine hull. A computational approach is desired that will predict the source strength of an implosion. This thesis covers the basic principals of underwater shock phenomena, including explosions and implosions. Drawing from previous experiments and computational simulations, a detailed investigation of the implosion event is made using DYSMAS, a coupled Eulerian-Lagrangian solver. DYSMAS is used to compare the characteristics of implosion and explosion events.

**KEYWORDS:** Implosion, UNDEX, Submarine, Shock Simulation, DYSMAS

## **UNSTEADY CASEWALL PRESSURE MEASUREMENTS IN A TRANSONIC COMPRESSOR**

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**Master of Science in Mechanical Engineering-June 2006**

**Advisor: Garth V. Hobson, Department of Mechanical and Astronautical Engineering**

**Second Reader: Anthony J. Gannon, National Research Council Research Associate**

During launch of aircraft off of a carrier deck, steam leakage is sometimes ingested into the aircraft's engine and may cause a compressor stall or "pop-stall." As the U.S. Navy prepares to field the single engine F-35C Joint Strike Fighter, it becomes necessary to investigate the phenomenon known as "pop-stall." In the present study, steady-state as well as transient measurements before and during a steam induced rotating stall are taken. Changes to the honeycomb alter the performance characteristics of the Transonic Compressor Rig and need to be remapped in order to determine a new stall line and peak performance criterion. Data is taken at 90 percent design speed and during a 70 percent steam induced stall with the aide of 9 Kulites at varying positions along the case wall. Data is reduced and analyzed through the use of a data acquisition and data reduction system.

**KEYWORDS:** Compressor, Transonic, Steam Ingestion, Turbulence, Stall

## **HIT-TO-KILL GUIDANCE ALGORITHM FOR THE INTERCEPTION OF BALLISTIC MISSILES IN THE BOOST PHASE**

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**Master of Science in Mechanical Engineering-June 2006**

**Advisor: Oleg Yakimenko, Department of Mechanical and Astronautical Engineering**

In this thesis, a near-optimal guidance law is developed using the direct method of calculus of variations that maximizes the kinetic energy transfer from a surface-launched missile upon interception to a ballistic missile target during the boost phase of flight. Mathematical models of a North Korean Taep'o-dong II (TD-2) medium-range ballistic missile and a Raytheon Standard Missile 6 (SM-6) interceptor are used to demonstrate the guidance law's performance. This law utilizes the SM-6's onboard computer and active radar sensors to independently predict an intercept point, solve the two-point boundary value problem, and

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determine a near-optimal flight path to that point. Determining a truly optimal flight path would require significant computing power and time, while a near-optimal flight path can be calculated onboard the interceptor and updated in real time without significant changes to the interceptor's hardware. That near-optimal guidance path is then converted into a set of command functions and fed back into the control computer of the interceptor. By modifying the second and third derivatives of the two-point boundary value problem, the intercept conditions can be varied to study their effects upon the optimal flight path regarding the maximization of kinetic energy upon impact.

**KEYWORDS:** Missile Guidance Laws, Direct Methods, Optimal Control, Boost Phase Intercept

### **PERFORMANCE COMPARISON BETWEEN ROUGH AND SMOOTH CAST BLADES IN A LOWSPEED MULTISTAGE COMPRESSOR**

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**Master of Science in Mechanical Engineering-June 2006**

**Advisor: Garth V. Hobson, Department of Mechanical and Astronautical Engineering**

**Second Reader: Raymond P. Shreeve, Department of Mechanical and Astronautical Engineering**

A performance comparison between smooth-cast and rough-cast blades is conducted in a low-speed multi-stage compressor. The purpose is to show that rough-cast blades can be used for initial performance tests of low-speed compressors. A baseline performance is established with smooth-cast epoxy blades and compared to rough-cast aluminum blades. The pressure-rise coefficient versus flow coefficient and velocity triangles are used as the measure for comparison between the different blade types. The velocity triangles are constructed and compared across the span (hub-to-tip) of the second-stage. This is done by using two probes that can traverse radially along the blade and sense the flow velocity and angle relative to the compressor axis. Measurements are taken at six different locations from the hub-to-tip of the blade. The performance tests are conducted at four different throttle settings: near stall, open throttle, nominal operating point (NOP), and near the NOP. Results show that although there are some differences between the smooth-cast and rough-cast blades, the overall performance is very similar. As a result, rough-cast blades could be used for initial performance tests or as the initial stages of a compressor in order to set up the flow for the evaluation of a new stage of smooth blades. The use of rough-cast blades in early stages would save the time and money needed to produce large numbers of high precision smooth-cast blades.

**KEYWORDS:** Low-Speed Multistage Compressor, Blade Roughness, Performance Measurements

### **FUEL INJECTION STRATEGIES FOR A NEXT-GENERATION PULSE-DETONATION ENGINE**

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**Master of Science in Mechanical Engineering-June 2006**

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**Second Reader: Christopher M. Brophy, Department of Mechanical and Astronautical Engineering**

The Pulse Detonation Engine offers the Department of Defense a new low cost, light weight, and efficient solution to supersonic flight on many of its small airborne platforms. In the past, both liquid fuel and gaseous fuel designs have been partially developed and tested. Several aspects of these configurations have led to the need for the development of a new design, in particular the reduction of total pressure losses, and the removal of auxiliary oxygen systems previously required to initiate a detonation wave in fuel-air mixtures within practical distances. Furthermore, higher repetition rates are required for practical thrust levels and the use of liquid fuels, as these are more attractive due to their higher energy densities.

A new PDE configuration is designed to operate on the liquid fuel, JP-10. The fuel injection system is characterized using laser diagnostics so that the fuel injection strategy could be optimized for the specified operating conditions. The timing parameters for the fuel-air injection profile are also characterized in order to deliver the desired amount and duration. This is a concurrent effort with computational simulations of

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the internal flow paths, design/integration of a novel transient plasma ignition system, and ongoing developments of a performance measurement test rig.

**KEYWORDS:** Pulse Detonation Engine, PDE, Transient Plasma Ignition, TPI, Detonation, Deflagration, JP-10

### FLOW-FIELD SURVEYS IN A TRANSONIC COMPRESSOR RIG

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**Master of Science in Mechanical Engineering-June 2006**

**Advisor: Garth V. Hobson, Department of Mechanical and Astronautical Engineering**

**Second Reader: Anthony J. Gannon, National Research Council Research Associate**

As the Navy prepares to transition to F-35C Joint Strike Fighter the need to understand “pop stalls” caused by steam leakage in catapult systems is of great concern. “Pop stalls” caused by steam ingestion through the aircraft engine result in a loss of power and possible total engine stall. The F-35C is a single engine aircraft and therefore the probability of a “pop stall” resulting in the loss of the aircraft is increased. Investigation of this phenomenon is currently being examined at the Turbopropulsion Laboratory by means of a transonic compressor rotor. The present study utilizes both three and five-hole probes to survey the flow field upstream and downstream of the rotor to examine compressor stability. A new compressor performance map is defined and a validation of previous steam ingestion is performed.

**KEYWORDS:** Compressor, Transonic, Steam Ingestion, Inlet Distortion, Turbomachinery, Pop Stall, Rotor

### PERFORMANCE OF A LIQUID FLOW, ULTRA-COMPACT, HEAT EXCHANGER

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**Master of Science in Mechanical Engineering-June 2006**

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**Second Reader: Jose O. Sinibaldi, Department of Mechanical and Astronautical Engineering**

A numerical analysis of the performance of compact pin-fin array heat exchangers is carried out using water and JP-4 fuel as the working fluids. Three different configurations are used with hydraulic diameters ranging from 0.137 to 0.777 mm, and volumetric area densities varying between 4.5 and 14.5 mm<sup>2</sup>/mm<sup>3</sup>. Numerical simulations are carried out to determine the performance of each heat exchanger over a series of Reynolds numbers in both the laminar and turbulent flow regimes. It is found that very large heat transfer coefficients (in the kW/m<sup>2</sup>K range) can be achieved compared to air for the same footprint. In addition, the simulations are used to predict the Reynolds number range for transition from laminar to turbulent flow, which is found to vary depending on the compactness of the heat exchanger configuration. As a final point, this study also investigates the effects of boiling of the liquid within the heat exchanger on its performance. It is found that despite improved heat transfer rates due to latent heat removal, vapor formation and resulting fluid expansion effects could result in undesirable flow patterns at low Reynolds numbers. The results from this study would be useful in the design of micro-scale heat exchangers for applications in the micro-electronic and gas turbine industries.

**KEYWORDS:** Pin Fin Array, Heat Exchanger, Micro Scale, Computational Fluid Dynamics, Laminar, Turbulent

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## **EFFECT OF SPAN VARIATION ON THE PERFORMANCE OF A CROSS-FLOW FAN**

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**B.S., United States Naval Academy, 1999**

**Master of Science in Mechanical Engineering-June 2006**

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**Second Reader: Knox. T. Millsaps, Department of Mechanical and Astronautical Engineering**

Over the past few decades, advances in aeronautic and control technologies have established a new vision for future air transportation systems. The National Aeronautics and Space Administration (NASA) has initiated the motion with several programs supporting the “highway of the sky,” a system of launch pads and air pathways enabling smaller and more easily piloted aircraft to travel the open space above instead of busy freeways and crowded city streets.

Previous investigations into crossflow fan technology as a propulsion source have identified its potential for use in personal aircraft and vertical takeoff and landing applications. To further development, performance characteristics must be determined for the possible configurations and under variable conditions to understand factors critical to design.

This experiment studies flow characteristics of a crossflow fan incorporating 30 blades of six-inch length in a six-inch diameter rotor. Comparison is made against the performance of a fan of similar design, but one-fourth the length span previously tested. Results are plotted for various parameters along constant speed lines of operation and general trends are determined. These results are used to quantitatively deduce scaling relationships for this device.

**KEYWORDS:** Crossflow Fan, Cross Flow Fan, Personal Air Vehicle Propulsion

## **EFFECT OF PRESSURE AND TEMPERATURE ON OIL-MIST SPRAYS USED FOR BLADE EXCITATION IN HIGH-CYCLE FATIGUE TESTING**

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**Master of Science in Mechanical Engineering-June 2006**

**Advisor: Raymond P. Shreeve, Department of Mechanical and Astronautical Engineering**

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

The flow patterns of two oil mist nozzles used in rotor blade excitation experiments are characterized using a Laser Doppler Velocimeter (LDV). Both nozzles are operated in a vacuum test chamber and velocity measurements are taken at three axial distances from the nozzle exit, at three or four different pressures, at three different temperatures. The four gallon per hour “mini-mist” nozzle produces a “referenced velocity” consistent with a hollow cone at each axial location, pressure, and temperature. The temperature of the oil flowing through the four gallon per hour nozzle does not affect the nozzle’s performance. The six gallon per hour “standard” nozzle produces a “solid” cone structure at each axial location, pressure, and temperature. The temperature of the oil flowing through the six gallon per hour nozzle does affect the nozzle’s performance. The spray pattern quantification can be used to design blade excitation experiments in high cycle fatigue (HCF) vacuum spin tests.

**KEYWORDS:** Oil Jet Excitation, Mist Nozzle, Laser Doppler Velocimetry, Rotor Spin Pit, High Cycle Fatigue, Blade Excitation, Flow Spray Empirical Model

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## LOSS MEASUREMENTS IN THE ENDWALL REGION OF A CASCADE OF COMPRESSOR BLADES AT STALL

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**Master of Science in Mechanical Engineering-June 2006**

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**Second Reader: Raymond P. Shreeve, Department of Mechanical and Astronautical Engineering**

Flow around second-generation controlled-diffusion blades in cascade at stall is investigated using five-hole probe surveys. Wake pressure surveys are conducted at various locations between the cascade centerline and endwall region. Corresponding inlet pressure surveys were also performed to allow the total pressure loss distribution to be calculated across the blades. A fully automated traverse mechanism is implemented for the probe surveys ahead of and aft of the cascade blades. The number of wake surveys conducted allows the pressure distribution profiles to show pressure deficiencies at the endwall region in greater detail than previous studies.

**KEYWORDS:** Controlled-Diffusion, Compressor, Cascade, Turbomachinery, Pressure Survey



# MASTER OF SCIENCE IN METEOROLOGY

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## EVALUATING ATLANTIC TROPICAL-CYCLONE-TRACK ERROR DISTRIBUTIONS BASED ON FORECAST CONFIDENCE

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**Master of Science in Meteorology-June 2006**

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**Second Reader: Russell L. Elsberry, Department of Meteorology**

A new Tropical Cyclone (TC) surface wind speed probability product from the National Hurricane Center (NHC) takes into account uncertainty in track, maximum wind speed, and wind radii. A Monte Carlo (MC) model is used that draws from probability distributions based on historic track errors. In this thesis, distributions of forecast track errors conditioned on forecast confidence are examined to determine if significant differences exist in distribution characteristics. Two predictors are used to define forecast confidence: the Goerss Predicted Consensus Error (GPCE) and the Global Forecast System (GFS) ensemble spread. The distributions of total-, along-, and cross-track errors from NHC official forecasts are defined for low, average, and high forecast confidence. Also, distributions of the GFS ensemble mean total-track errors are defined based on similar confidence levels. Standard hypothesis testing methods are used to examine distribution characteristics. Using the GPCE values, significant differences in nearly all track error distributions exist for each level of forecast confidence. The GFS ensemble spread does not provide a basis for statistically different distributions. These results suggest that the NHC probability model would likely be improved if the MC model would draw from distributions of track errors based on the GPCE measures of forecast confidence.

**KEYWORDS:** Tropical Cyclone, Track Errors, CONU, Consensus, GPCE, Forecast Confidence, National Hurricane Center, Monte Carlo Model, Probabilistic Forecast, Wind Speed Probability

## EVALUATION OF CAUSES OF LARGE 96-H AND 120-H TRACK ERRORS IN THE WESTERN NORTH PACIFIC

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**B.S., Texas A&M University, 2001**

**Master of Science in Meteorology-June 2006**

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Whereas the Joint Typhoon Warning Center (JTWC) has ten track forecasts to 72 h, only four dynamical model forecasts are available at 96 h and 120 h. Forming a selective consensus (SCON) by proper removal of a likely erroneous track forecast is hypothesized to be more accurate than the non-selective consensus (NCON) of all four models. Conceptual models describing large track error mechanisms, which are related to known tropical cyclone motion processes being misrepresented in the dynamical fields, are applied to forecasts by the Navy Operational Global Atmospheric Prediction System (NOGAPS), the U.S. Navy version of the Geophysical Fluid Dynamics Laboratory Model (GFDN), the United Kingdom Met Office (UKMO), and the National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) during the 2005 western North Pacific typhoon season. A systematic error in the GFDN was identified in which the model built a false anticyclone downstream of the Tibetan Plateau, which explained over 50% of the large GFDN track errors. In the GFS model, 95% of the large errors occurred due to an incorrect depiction of the vertical structure of the tropical cyclone. The majority of NOGAPS and UKMO large errors were caused by an incorrect depiction of the midlatitude system evolutions. Characteristics of the

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erroneous forecast tracks and corresponding model fields are documented and illustrative case studies are presented. By applying rules of the Systematic Approach, the average SCON error was 222 n mi (382 n mi) less than NCON (JTWC) in 20% of all 120-h forecasts.

**KEYWORDS:** Tropical Cyclone Track Forecasting, Systematic Approach, Track Error Mechanisms Conceptual Models, Joint Typhoon Warning Center, Western North Pacific Typhoons

## VARIABILITY IN GLOBAL-SCALE CIRCULATIONS AND THEIR IMPACTS ON ATLANTIC TROPICAL-CYCLONE ACTIVITY

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**Thomas Murphree, Department of Meteorology**

In this study, intraseasonal variations in Southern Hemisphere midlatitude large-scale circulations are examined with respect to environmental factors over the tropical North Atlantic that may be favorable or unfavorable for tropical cyclone formation. Favorable impacts on tropical Atlantic circulation characteristics are defined by an increase in low-level relative vorticity, a decrease in westerly vertical wind shear, and increased convection in the West African monsoon (WAM).

The second and third modes of an empirical orthogonal function (EOF) analysis of the 700-hPa height anomalies identify a distinct Rossby-wave pattern. Significant variability in the Southern Hemisphere mid-latitude circulations is related to the two EOF modes and to equatorward Rossby-wave dispersion.

Formation of a large cyclonic anomaly over the southeast Pacific, west of Chile, is related to equatorward propagation of a Rossby-like wave across South America, toward the equatorial Atlantic. The cyclonic anomaly precedes an increase in WAM convection by an average of two days, which then precedes westerly wind anomalies over the equatorial North Atlantic by several days. Tropical cyclone formation is found to be enhanced when the increased equatorial westerly anomalies coincide with reduced vertical wind shear, which is related to Northern Hemisphere midlatitude circulations.

**KEYWORDS:** Southern Hemisphere Midlatitudes, Rossby-Wave Dispersion, Large-scale Tropical Circulations, Intraseasonal Variability, Tropical Cyclones, Tropical North Atlantic, Antarctic Oscillation

# **MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY**

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## **OBJECTIVELY DETERMINED MODEL-DERIVED PARAMETERS ASSOCIATED WITH FORECASTS OF TROPICAL-CYCLONE FORMATION**

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**Master of Science in Meteorology and Physical Oceanography-June 2006**

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During the 2005 North Atlantic hurricane season, an objective tropical cyclone vortex identification and tracking technique is applied to analyzed and forecast fields of three global operational numerical models - the National Centers for Environmental Prediction Global Forecast System (GFS), the Navy Operational Global Atmospheric Prediction System (NOGAPS), and the United Kingdom Meteorological Office model (UKMET). For the purpose of evaluating each model's performance with respect to forecasting tropical cyclone formation, 14 relevant parameters are cataloged for every tropical vortex.

In this study, nine of the fourteen parameters are subjected to a linear discriminant analysis applied to all forecast vortices that exceed vorticity and warm core thresholds. The goal is to determine the combination of parameters for each model, at each 12-h forecast period to 120h, that best discriminates between a vortex that is correctly forecast to intensify into a tropical cyclone (developer) and a vortex that is forecast to intensify into a tropical cyclone, but does not (false alarm). The performance of the resulting discriminant functions are then assessed using the Heidke Skill Score and Receiver Operating Characteristic curves. Overall, the methodology applied to forecasts from the UKMET model shows the most skill with regard to identifying correct forecasts of tropical cyclone formation.

**KEYWORDS:** Tropical Cyclone, Tropical Cyclone Formation, Hurricane, Linear Discriminant Analysis

## **THREE-DIMENSIONAL ANALYSIS OF AZIMUTHAL DEPENDENCE OF SOUND PROPAGATION THROUGH SHALLOW-WATER INTERNAL SOLITARY WAVES**

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Results from shallow-water observational studies have shown acoustic field fluctuations in excess of 10 dB due primarily to non-linear internal solitary waves (ISWs). This work concentrates on three limitations ISWs pose to shallow-water acoustic propagation: anisotropy, quasi-deterministic-stochastic nature, and frequency dependence. These aspects are explored for low frequencies of 75 and 150 Hz through the development of a full-wave three-dimensional parabolic equation model in which a single ISW is introduced and rotated to achieve differing geometries between the ISW and acoustic transmission path. Two acoustic scattering regimes are found to exist: a horizontal refractive regime that generates very intense acoustic energy focusing and shadow zones near the ISW at range when the acoustic transmission path is nearly parallel to the ISW crest, and a vertical mode coupling regime producing moderate to strong acoustic energy focusing and shadow zones for all geometries. These three-dimensional patterns are similar for each frequency, but more intense for 150 Hz. The results dramatically show ISWs focus acoustic

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energy, dependent upon frequency and geometry, which may be exploitable in both a sonar performance and ambient noise modeling sense.

**KEYWORDS:** Internal Solitary Wave, Soliton, Shallow-Water Acoustic Propagation, Volume Scattering, Mode Coupling, Parabolic Equation Model

# **MASTER OF SCIENCE IN MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION**

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## **HUMAN BEHAVIOR REPRESENTATION OF MILITARY TEAMWORK**

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This work presents a conceptual structure for the behaviors of artificial intelligence agents, with emphasis on creating teamwork through individual behaviors. The goal is to set up a framework which enables teams of simulation agents to behave more realistically. Better team behavior can lend a higher fidelity of human behavior representation to a simulation, as well as provide opportunities to experiment with the factors that create teamwork. The framework divides agent behaviors into three categories: leadership, individual, and team-enabling. Leadership behaviors consist of planning, decision-making, and delegating. Individual behaviors consist of moving, shooting, environment-monitoring, and self-monitoring. Team-enabling behaviors consist of communicating, synchronizing actions, and team member monitoring. These team-enabling behaviors augment the leadership and individual behaviors at all phases of an agent's thought process, and create aggregate team behavior that is a hybrid of emergent and hierarchical teamwork. The net effect creates, for each agent, options and courses of action which are sub-optimal from the individual agent's standpoint, but which leverage the power of the team to accomplish objectives. The individual behaviors synergistically combine to create teamwork, allowing a group of agents to act in such a manner that their overall effectiveness is greater than the sum of their individual contributions.

**KEYWORDS:** Human Behavior Representation, HBR, Agent-Based Modeling, Artificial Intelligence, Teamwork, Team-Enabling Behaviors

## **A TEAMWORK-ORIENTED AIR-TRAFFIC-CONTROL SIMULATOR**

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Air Traffic Control (ATC) is a complicated domain in which many specialists should collaborate and communicate with each other in order to guarantee safe and efficient air traffic. A significant number of air traffic control errors are associated with either faulty coordination between ATC actors or a failure of some kind of team coordination. These errors are likely to increase in the future as aircraft density increases. Many researchers suggest that the introduction of team and teamwork concepts during the training phase of the ATC actors will be of assistance in reducing the amount of these errors.

The objective of this research is to conceive, design, and implement a teamwork-oriented Air Traffic Control simulator that can be easily installed and used in ATC schools. The product of this thesis is a

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complete software package that allows trainees in the different ATC specialties to work together in the same manner as they do “on-the-job” in order to collaboratively manage an air traffic situation. This type of simulator should allow air traffic control trainees to acquire more robust coordination skills and reduce the amount of traffic control errors caused by lack of teamwork in actual ATC training situations.

**KEYWORDS:** Air Traffic Control, Teamwork, Simulation, Pilot, En-Route Controller, Approach Controller, Tower Controller, XML, OOP, RMI

### **AN EXPLORATION OF EQUIPPING A FUTURE FORCE WARRIOR SMALL COMBAT UNIT WITH NON-LETHAL WEAPONS**

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The U.S. military has an increasing requirement to prepare for and conduct urban operations (UO). This UO requirement spreads across the spectrum of conflict, from high intensity combat to peacekeeping and humanitarian (Stability and Support Operations—SASO) missions, perhaps simultaneously. Regardless of which portion(s) of the warfare spectrum U.S. forces are involved in, urban engagements are inevitable and present major challenges. Superior standoff weapons ranges and combined arms tactics are quickly negated in the confined terrain of a complex and usually unfamiliar urban environment. Often considerably more challenging is the ability to differentiate the enemy from noncombatants—endangering soldiers and their mission. Conventional forces, armed only with traditional weapons, normally have two options: the threat of a violent response (passive) or the use of deadly force (active). These two extremes have virtually no middle ground. The reluctance of military and/or peacekeeping forces to employ deadly force on unconfirmed enemy targets creates a vulnerability. This vulnerability may be mitigated by equipping a small combat unit (SCU) with a viable alternative to deadly force—non-lethal weapons (NLWs).

Using an imperfect friend or foe identification modeling framework within an agent-based simulation (ABS), an NLW is essentially used to interrogate (determine the intent of the person in order to identify friend or foe) rather than attempt to incapacitate a target. To determine the impacts of employing NLWs in an urban combat environment (with civilians on the battlefield), three factors are varied across 15 design points: the ability of U.S. military forces to positively identify a target, the range of the selected NLW, and the distribution/number of NLWs in an SCU. By replicating each design point and analyzing the resulting output data, the following insights are determined: the use of NLWs does not degrade U.S. survivability; NLWs are essential to neutralizing suicide attacks; and NLWs decrease civilian casualties.

**KEYWORDS:** Non-Lethal Weapons, Urban Operations, Future Force Warrior, Agent-Based Simulations

# MASTER OF SCIENCE IN OPERATIONS RESEARCH

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## **ARMY RESERVE ENLISTED AGGREGATE FLOW MODEL**

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Recent world events have affected the rates at which the United States Army Reserve (USAR) recruits and retains enlisted members. As these rates fluctuate, it becomes difficult for the USAR to forecast its recruiting requirements. This thesis describes a statistical model and an associated software tool designed to provide precise forecasts of aggregate USAR enlisted personnel trends. In particular, the tool can assist in forecasting specific USAR enlisted end-strength requirements using aggregate accession, retention, and attrition rates. Entitled the Army Reserve Enlisted Aggregate Flow Model (AREAFM), the tool uses a Markov Growth Model and, for the purposes of this thesis, it is standardized using fiscal year 2001 (FY01) through FY03 data and validated with FY04 data. The AREAFM is intended for annual use in forecasting the number of enlisted accessions required to achieve USAR end-strength. The model can also be used to evaluate how adjustments in accession, promotion, and attrition rates, perhaps as the result of changes in USAR manpower policies or current events, might affect the assigned strength.

**KEYWORDS:** USAR, Manpower Modeling, Enlisted Modeling, Army Reserve, Military Manpower Modeling, Markov Growth Model

## **OPTIMIZING COMPUTER ADAPTIVE TEST (CAT)-ARMED SERVICES VOCATIONAL APTITUDE BATTERY (ASVAB) ITEM SELECTION USING FORM ASSEMBLY TECHNIQUES**

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The Armed Services Vocational Aptitude Battery (ASVAB) is a test that approximately 700,000 students in 12,000 high schools take each year to determine military occupation placement. Form Assembly for the ASVAB refers to the selection of 20-35 questions, known as items, from an item pool of approximately 300 items to create a paper and pencil test in one of its ten topics. Previous research formulates form assembly as an Integer Linear Program (ILP). The current ASVAB primarily uses a Computer Adaptive Test (CAT), which estimates an examinee's ability after the examinee answers each item and selects the next item based on prior performance. The current CAT-ASVAB implementation does not control the number of items selected from each subject (taxonomy group) for a test. This thesis introduces ILPs, previously used for form assembly, that impose taxonomy restrictions and applies them to the CAT-ASVAB. Four ILP variations are created and tested against the current method of item selection by simulating 3,500 examinees (500 examinees each for seven given ability levels). The results show that all of the ILPs have acceptable solution times for CAT use, and taxonomy restrictions can be imposed while also having more even exposure rates (the number of times an item is administered divided by the number of examinees) than the current implementation of the CAT-ASVAB. A variation that relaxes most of the binary variables and constrains the difficulty of each item to be within a predetermined magnitude of the current ability estimate

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performs the best in terms of item exposure (for both under- and over-utilized items) and error between an examinee's estimated ability level and actual ability level.

**KEYWORDS:** Computer Adaptive Test, ASVAB, Integer Linear Program, Shadow Test

### **AN UPGRADEABLE AGENT-BASED MODEL TO EXPLORE NON-LINEARITY AND INTANGIBLES IN PEACEKEEPING OPERATIONS**

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**Second Reader: Arnold H. Buss, MOVES Institute (Modeling, Virtual Environments and Simulation)**

Peacekeeping operations (PKO) have become a significant challenge to the German Armed Forces. For the development of tactics, techniques, procedures, and equipment with combat operations, agent-based models have been developed, used, and exploited for many years. Modeling and simulation of PKO, however, is still in a very early stage. This thesis develops an agent-based model to analyze PKO. Unlike many other multi-agent systems (MAS), it implements the rules of discrete event simulation. The chosen software architecture makes the model upgradeable and useful for a breadth of future applications. The model's open architecture and the underlying principle of loosely coupled components make it easy to change or enhance the model. The software agents' design incorporates individuality, which is characterized by personality factors. Furthermore, the model is data-farmable. Required data inputs into the simulation tool, i.e., PKO scenarios, are formatted utilizing a state-of-the-art technology called Extensible Markup Language (XML), which facilitates use of the data in nearly all computer software packages. The model executes multiple runs of multiple scenarios automatically, demonstrating a robust nature. Finally, an exemplary analysis demonstrates data-farming concepts on the effect of personality factor settings on the potential escalation of a PKO scenario.

**KEYWORDS:** Modeling, Simulation, Peacekeeping Operations, Multi-Agent System, Agent-Based Simulation, Discrete Event Simulation, Data Farming, Design of Experiment

### **AN ANALYSIS OF THE EFFECT OF SURFACE WARFARE OFFICER CONTINUATION PAY (SWOCP) ON THE RETENTION OF QUALITY OFFICERS**

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**Master of Science in Operations Research-June 2006**

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The quality of officers serving in Department Head afloat billets influences the combat effectiveness of a ship. The Surface Warfare Officer Continuation Pay (SWOCP) was established to retain more quality officers in the Department Head ranks. This thesis addresses quality as a quantitative value that is a function of an individual's fitness reports (FITREPs) and a time decay factor. A statistical study of the data shows no significant effect of SWOCP on the quality of officers retained. The bonus also has no significant influence on an officer's downstream performance. Based on these conclusions, it appears that the SWOCP has served primarily as a retention tool for quantity rather than quality.

**KEYWORDS:** Surface Warfare Officer, SWOCP, Department Head, Retention, HCI, Bonus, FITREP

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## A STATISTICAL ANALYSIS OF WIRELESS NETWORKING: PREDICTING PERFORMANCE IN MULTIPLE ENVIRONMENTS

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In this thesis, the use of a standard 802.11g wireless signal in a signal hostile and unfriendly (i.e., high temperature, high humidity) environment is analyzed. Since the goal of the research project is to demonstrate the feasibility and use of commercially available products in a tactical and operational manner, the effects that might occur between environmental factors (temperature, humidity, pressure, etc.) and the 802.11 signal are analyzed, specifically, whether the signal throughput is affected at all in the presence of these factors. The analysis attempts to identify any types of interactions that are occurring, and whether those interactions have a positive or negative affect on throughput. In addition, what kind of losses, if any, can be expected in different environments.

**KEYWORDS:** 802.11g, Throughput, Wireless Network, Humidity, Temperature, Pressure, Environmental Effects, Throughput, Regression Analysis

## ANALYSIS OF THE ASSIGNMENT SCHEDULING CAPABILITY FOR UNMANNED AERIAL VEHICLES (ASC-U) SIMULATION TOOL

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Master of Science in Operations Research-June 2006

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The U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) and the MOVES Institute (Modeling, Virtual Environments, and Simulations) at the Naval Postgraduate School, Monterey, California, developed the Assignment Scheduling Capability for Unmanned Aerial Vehicles (UAVs) (ASC-U) simulation to assist in the analysis of UAV requirements for the Future Force. ASC-U employs a discrete event simulation coupled with the optimization of a linear objective function. At regular intervals, ASC-U obtains an optimal solution to a simplified problem that assigns available UAVs to missions that are available or will be available within a future time horizon.

This thesis simultaneously explores the effects of 26 simulation and UAV factors on the mission value derived when allocating UAVs to mission areas. The analysis assists in defining the near-term (2008) UAV force structure and the investment strategy for the mid-term (2013), and far-term (2018). An efficient experimental design, exploratory modeling, and data analysis are combined to examine 514 variations of a scenario involving five UAV classes and over 21,000 mission areas. The conclusions suggest the following: the optimization interval significantly influences the quality of the problem solution, percent mission coverage may depend on a few UAV performance factors, small time horizons increase percent mission coverage, and carefully planned designs assist in the exploration of the outer and interior regions of the response surface.

**KEYWORDS:** Nearly Orthogonal Latin Hypercube, Design of Experiments, DOE, Multiple Regression Analysis, Simulation Analysis, Unmanned Aerial Vehicles, UAV, Discrete Event Simulation, SIMKIT, Future Combat Systems, FCS, Optimization

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## EMERGENCY FIRST RESPONSE TO A CRISIS EVENT: A MULTI-AGENT SIMULATION APPROACH

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Homeland Security Presidential Directive #8 led to the establishment of the National Exercise Program and the Top Officials (TOPOFF) exercise series to test and evaluate first response agency integration and effectiveness. The last TOPOFF exercise cost \$16M and involved over 10,000 people but did not effectively leverage simulation techniques to make efficient use of resources.

This research adapts an existing organizational learning process, integrating low- and high-resolution simulation to provide decision support. This process led to the development of a multi-agent simulation methodology for emergency first response, specifically applied to analyze a notional vehicle bomb attack during a festival in the Baltimore Inner Harbor.

This simulation demonstrates the potential benefits of low-resolution simulation, using efficient experimental design and high-performance computing. Combined, these two ideas result in examining a 48-dimensional response surface and using over 156 CPU centuries of computer time. All experiments were completed in less than three weeks.

The analysis of this data set provides insight into several areas, including the importance of standing operating procedures in the early moments of a crisis. Analysis shows that effective procedures may even be more important than the effectiveness of communications devices early in a first response operation.

**KEYWORDS:** Homeland Security, Crisis Response, First Response, Emergency Services, Organizational Learning, Low Resolution, Multi-Agent Simulation, Baltimore, Inner Harbor, Bomb Response, Agent Based Model, Agent Based Simulation, Design of Experiments, Terrorism, Anti-Terrorism

## AN EXPLORATION OF EQUIPPING A FUTURE FORCE WARRIOR SMALL COMBAT UNIT WITH NON-LETHAL WEAPONS

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The U.S. military has an increasing requirement to prepare for and conduct urban operations (UO). This UO requirement spreads across the spectrum of conflict, from high intensity combat to peacekeeping and humanitarian (Stability and Support Operations—SASO) missions, perhaps simultaneously. Regardless of which portion(s) of the warfare spectrum U.S. forces are involved in, urban engagements are inevitable and present major challenges. Superior standoff weapons ranges and combined arms tactics are quickly negated in the confined terrain of a complex and usually unfamiliar urban environment. Often considerably more challenging is the ability to differentiate the enemy from noncombatants—endangering soldiers and their mission. Conventional forces, armed only with traditional weapons, normally have two options: the threat of a violent response (passive) or the use of deadly force (active). These two extremes have virtually no middle ground. The reluctance of military and/or peacekeeping forces to employ deadly force on unconfirmed enemy targets creates a vulnerability. This vulnerability may be mitigated by equipping a small combat unit (SCU) with a viable alternative to deadly force—non-lethal weapons (NLWs).

Using an imperfect friend or foe identification modeling framework within an agent-based simulation (ABS), an NLW is essentially used to interrogate (determine the intent of the person in order to identify friend or foe) rather than attempt to incapacitate a target. To determine the impacts of employing NLWs in an urban combat environment (with civilians on the battlefield), three factors are varied across 15 design points: the ability of U.S. military forces to positively identify a target, the range of the selected NLW, and the distribution/number of NLWs in an SCU. By replicating each design point and analyzing the resulting

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output data, the following insights are determined: the use of NLWs does not degrade U.S. survivability; NLWs are essential to neutralizing suicide attacks; and NLWs decrease civilian casualties.

**KEYWORDS:** Non-Lethal Weapons, Urban Operations, Future Force Warrior, Agent-Based Simulations



# MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

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## **DYNAMICS OF EASTERN BOUNDARY CURRENTS AND THEIR EFFECTS ON SOUND-SPEED STRUCTURE**

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Identifying the influence of eastern boundary current (EBC) dynamical processes on sound speed structure can provide better ocean models for acoustic predictions in littoral regions. This study explores the effects of currents, wind, and eddies on the sound speed structure of two different EBC models, the North Canary Current System (NCCS) and the Leeuwin Current System (LCS). These systems represent classical features of EBCs as well as regional anomalies. This study introduces sound speed analysis to the sigma coordinate primitive equation models and determines which regions of EBCs experience the largest changes in sound speed and the most intense gradients. Results of model runs show that the dynamics of EBCs lead to large changes in sound speed and distort the vertical sound speed profile. The greatest change in sound speed in either region is caused by upwelling in the NCCS. Surface and associated subsurface eddies in the LCS are the largest scale feature in the study. The undercurrent of the NCCS and Meddies present the most intense (horizontal and vertical) gradients of sound speed change.

**KEYWORDS:** Primitive Equation Model, Leeuwin Current System, North Canary Current System, Sigma-Level, Princeton Ocean Model, POM, Sound Speed, Eastern Boundary Current, Undersea Warfare

## **TWO DIMENSIONAL ACOUSTIC PROPAGATION THROUGH OCEANIC INTERNAL SOLITARY WAVES: WEAK SCATTERING THEORY AND NUMERICAL SIMULATION**

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Internal solitary waves, or solitons, are often generated in coastal or continental shelf regions when tidal currents advect stratified water over bathymetric relief, creating an internal tide which non-linearly evolves into one or more solitons. A major consequence of solitons in a stratified environment is the vertical displacement of water parcels, which can lead to sound speed variability of order 10m/s with spatial scales of order 100 meters and timescales of order minutes. Thus, significant variations in sonar performance on both surface based ships and submarines can be expected. An understanding of the nature of acoustic propagation through these waves is vital for future development of sonar prediction systems. This research investigates acoustic normal mode propagation through solitons using a 2D parabolic equation simulation and weak acoustic scattering theory whose primary physics is a single scatter Bragg mechanism. To simplify the theory, a Gaussian soliton model is developed that compares favorably to the results from a traditional sech<sup>2</sup> soliton model. The theory of sound through a Gaussian soliton is then tested against the numerical simulation under conditions of various acoustic frequency, source depths, soliton position relative to the source, and soliton number. The theoretical results compare favorably with numerical simulations at 75, 150, and 300-Hz. Higher frequencies need to be tested to determine the limits of the first order theory. Higher order theory will then be needed to address even higher frequencies and to deal with

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weakly excited modes. This research is the first step in moving from a state of observing acoustic propagation through solitons, to one of predicting it.

**KEYWORDS:** Oceanography, Weak Scattering Theory, Bragg Scattering, Soliton, Mode Coupling, Mode Energy, Acoustic Propagation, 2D Parabolic Equation, Internal Solitary Wave

# MASTER OF SCIENCE IN PHYSICS

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## HERMITE-GAUSSIAN MODES AND MIRROR DISTORTIONS IN THE FREE-ELECTRON LASER

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The free electron laser (FEL) is proposed to meet the Navy's need for a speed-of-light high energy laser weapon capable of engaging a variety of targets, including anti-ship cruise missiles, small boats, and theater ballistic missiles. A key attribute of FELs is good optical beam quality; in other words, they operate in only a few of the lowest-order transverse Gaussian modes. For weapons applications, a good mode quality is desired because it delivers the highest intensity on target, ensuring a high level of lethality. A few higher-order modes can arise from the interaction of the electron beam with the optical beam, or from misalignments of the electron beam or resonator mirrors. High intensity on FEL optics can lead to mirror distortion due to heating and insufficient cooling of the mirror substrate. Mirror distortions, including astigmatism, can cause higher-order modes to appear, affecting FEL performance. Therefore, it is important to quantify these higher-order modes because doing so uniquely identifies the optical field and may allow for corrective optics to single out the best modes for FEL lethality.

This thesis reviews free electron laser theory, and for the first time develops analytical solutions to quantify Hermite-Gaussian higher-order modes, develop a diagnostic for modal analysis, and determine the tolerance limits on mirror distortions.

**KEYWORDS:** Free Electron Laser, High Energy Laser, Astigmatism, Hermite, Gaussian, Modes, Higher Order Modes, Hermite-Gaussian



# **MASTER OF SCIENCE IN PROGRAM MANAGEMENT**

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**AN ANALYSIS OF THE U.S. NAVY VERIFICATION, VALIDATION, AND ACCREDITATION (VV&A) PROCESS FOR MODELING AND SIMULATION (M&S) USED FOR OPERATIONAL TEST (OT) OF SURFACE SHIPS AND WEAPONS**

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**Master of Science in Program Management-June 2006**

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In this climate of declining budgets and resources, models and simulations (M&S) have become very beneficial to the U.S. Navy. However, the U.S. Navy's investment in and use of M&S for addressing critical operational issues (COIs) within a warship's operational test (OT) program would not be practical unless the particular M&S was determined to be a credible representation of that which would be physically tested. Commander Operational Test and Evaluation Force (COMOPTEVFOR) is responsible for accrediting U.S. Navy M&S that are required to support OT. COMOPTEVFOR has developed a Verification, Validation, and Accreditation (VV&A) process that is documented in COMOPTEVFORINST 5000.1A. This instruction requires all surface ship acquisition program managers (PMs) to develop a Validation and Verification (V&V) plan that would meet COMOPTEVFOR's expectations for likely accreditation. This thesis identifies the extent to which surface ship PMs are complying with COMOPTEVFORINST 5000.1A; why they are not in full compliance with the instruction; what incentives would help them comply with the instruction; and what improvements can be made to the instruction that would increase compliance by the PMs. Finally, this thesis concludes with recommendations that would help increase compliance with the instruction by the PMs.

**KEYWORDS:** Modeling and Simulation, Verification, Validation, and Accreditation, Navy, Operational Test, Surface Ship, Acquisition, Program Manager



# MASTER OF SCIENCE IN SOFTWARE ENGINEERING

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## THE EVALUATION OF PROJECT MANAGEMENT ABILITY ON TWO SOFTWARE MAINTENANCE PROJECTS BASED ON A CMMI FRAMEWORK

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As software systems increase in size and complexity, so does the need to predict and control scope, schedule, and costs. The United States General Accountability Office has acknowledged weaknesses in the software acquisition process. Industry data indicates that improving the software development process can have significant effect on a project team's ability to generate products within planned scope, schedule, and cost estimates. This thesis focuses on software maintenance, one phase of the Army's acquisition process, to demonstrate that stronger management practices are needed to make better predictions and assessments in those areas. Two software maintenance projects are evaluated for success in project management performance against CMMI practices. This research results in a set of recommendations and predicted benefits are provided for use by the organization as input to the next process improvement effort.

**KEYWORDS:** CMMI, Project Management, Process Improvement, Software Maintenance

## INTELLIGENT MAINTENANCE AID

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Technological complexities of current ground combat systems require advanced maintenance methods to keep the fleet in a state of operational readiness. Currently, maintenance personnel use paper Technical Manuals (TM) that are cumbersome and not easily transportable or updated in the field. This thesis proposes using the latest technology to support maintainers in the field or depot by integrating the TMs with the onboard diagnostics Built-In-Test (BIT) and Fault Isolation Test (FIT) of the vehicle, to provide the maintainer with an improved diagnostics tool to expedite troubleshooting analysis.

This is accomplished by connecting the vehicle (using the vehicle's 1553 multiplex bus) with the Graphical User Interface (GUI) of an Intelligent Maintenance Aid (IMA). The IMA uses Troubleshooting Procedure (TP) codes generated during BIT and FIT testing. Using the information provided by these TP codes, through the IMA graphical user interface (GUI), information from the technical manuals is displayed to aid the maintainers in their diagnostic work.

The results of this thesis serve as a baseline for further research and will be presented to the Program Management Office for Combat Systems (PM-CS) for further consideration and development.

**KEYWORDS:** Built In Test, BIT, Fault Isolation Test, FIT, Maintenance, Vehicle Electronics, 1553 Multiplex Bus



# **MASTER OF SCIENCE IN SYSTEMS ENGINEERING**

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## **A MODEL FOR THE ORDERING AND DISTRIBUTION OF THE INFLUENZA VACCINE**

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**Master of Science in Systems Engineering-June 2006**

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The system for the production and distribution of the United States supply of influenza vaccine has experienced disruptions during past influenza seasons. The identification of elements of the influenza vaccine is different each year and must be researched and identified each year prior to the influenza season. The manufacturing of the vaccine is a complicated process with many potential problems. This thesis identifies the requirements and constraints of the current manufacturing and distribution system, including the annual demand and supply. This information is used to create a model based on operational research and operational management theory to develop a systematic approach to distribution of the influenza vaccine in a shortage situation. Two different policies are identified for use in a normal influenza season to determine how many companies are required to provide a sufficient amount of influenza vaccine (with the understanding that some of the companies might have manufacturing difficulties). These two policies are the percentage distribution policy and the strict priority distribution policy. The model includes a determination of the number of companies that should be available for influenza vaccine production and the amount of vaccine that should be ordered from each company to minimize the total cost. The majority of the influenza seasons could be covered by purchasing fewer than 108 million doses, as in the percentage distribution policy, making sure that the vaccine dose orders are spread out evenly over four companies and distributed evenly by age group percentage. If necessary, the amount of vaccine purchased could be reduced to as little as 24.5 million doses with minimal cost and loss of life by using a strict priority distribution policy.

**KEYWORDS:** Vaccine, Vaccine Supply, Flu Vaccine, Vaccine Ordering, Vaccine Shortage, Pandemic

## **PERFORMANCE ANALYSIS OF THE IEEE 802.11G WAVEFORM TRANSMITTED OVER A FADING CHANNEL WITH PULSE-NOISE INTERFERENCE**

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**Master of Science in Electrical Engineering-June 2006**

**Master of Science in Systems Engineering-June 2006**

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The performance of the most promising wireless local area network (WLAN) standards today, IEEE 802.11g, which specifies orthogonal frequency-division multiplexing (OFDM) in order to avoid multi-path effects and at the same time achieve high data rates, is examined in this thesis. Four different receivers are investigated and their performance is analyzed with Viterbi soft decision decoding when the signal is transmitted over a slow, flat fading Nakagami channel for additive white Gaussian noise (AWGN) only, as well as for AWGN plus pulse-noise interference (PNI). The implementation of forward error correction (FEC) coding with soft decision decoding (SDD) improves the performance compared to uncoded signal if pulse-noise interference is not present. The scenarios when no side information is available (linear-combining receiver), when perfect side information is available (noise-normalizing receiver), and two alternatives to the noise-normalized receiver with much coarser side information (modified noise-normalized receiver and noise-normalized receiver with normalization error) are examined. All the

scenarios are examined for various fading and interference conditions. The performance of the noise-normalized receiver is, as expected, much improved compared to the linear-combining receiver when PNI is present. Finally, the noise-normalized receiver with normalization error achieves the same or better performance than the noise-normalized receiver without the exact interference noise power.

**KEYWORDS:** Nakagami Fading Channel, Pulse-Noise Interference, Interference Mitigation, Convolutional Coding

# MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY

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## TEST AND EVALUATION OF A PROTOTYPED SENSOR-CAMERA NETWORK FOR PERSISTENT INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE IN SUPPORT OF TACTICAL COALITION NETWORKING ENVIRONMENTS

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**James F. Ehlert, Department of Information Sciences**

This thesis investigates the feasibility of deploying an integrated sensor-camera network in military and law enforcement applications. The system is built using entirely commercial, off-the-shelf technologies. The prototype uses unattended ground sensors combined with digital video surveillance cameras to provide accurate real-time situational awareness, persistent intelligence, and remote security.

A robust testing and evaluation plan is created to measure the system's performance based on specific metrics. The tests focus primarily on the capabilities of the sensor aspect of the network. Tests are conducted to determine the maximum detection range, probabilities of detection, maximum communications range, and battery life. Mathematical models are created to assist network planners. Additionally, the prototyped system is tested through field exercises as part of the Naval Postgraduate School's Coalition Operating Area Surveillance and Targeting System field demonstrations in California and northern Thailand. Although the sensing capabilities exceed the minimum metrics, the system is not suitable for use in military applications. However, the prototyped network would work well in less demanding law enforcement environments. Additionally, the feasibility and the need to develop an integrated sensor-camera network are demonstrated.

**KEYWORDS:** Integrated Sensors, Surveillance, Digital Video, Metrics, Coalition Networking, Prototype, Test and Evaluation

## AERIALLY DEPLOYED REAL-TIME TARGETING SENSOR NET

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**Second Reader: LtCol Karl D. Pfeiffer, USAF, Department of Information Sciences**

This thesis focuses on developing and analyzing a model for an aerially deployed, real-time, targeting sensor net to close the current gap that exists between the potential technological-doctrinal capability within society and that of the military. This thesis outlines current real-time targeting need due to the decomposition of warfare after the fall of the Soviet Union, and portrays the targeting discrepancies in the Global War on Terror. From end-user surveys, requirements are laid out for a system of systems to meet targeting needs. A feasible solution consisting of a system architecture anchored in existing commercial, off-the-shelf technology is proposed to meet the discrete deliverables necessary to accomplish targeting goals to deal with asymmetric threats in opaque environments.

**KEYWORDS:** Sensor Net, Targeting, Wireless Mesh, C2, Command and Control, Special Operations, Asymmetric Warfare, Capability Gaps, Special Forces, Targeting, Decomposition, Real-Time, Ultra Wideband, TNT, COASTS, Aerial Deployment, Ad-Hoc Networks, Sensor Network, Sensor Feed, Common Operational Picture, EMF Detection, Complex Targeting, Real-Time Communication, Jungle Insurgency, ISR, Intelligence, Surveillance, Reconnaissance

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## SYSTEMS TECHNOLOGY

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### AN ASSESSMENT OF JOINT CHAT REQUIREMENTS FROM CURRENT USAGE PATTERNS

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This research assesses the impact of synchronous (real-time), text-based chat on military command and control (C2) processes. Chat use among the services, particularly among joint forces, has evolved in ad hoc fashion to fill gaps in currently fielded C2 systems. This growth-by-improvisation inhibits clear definition of the underlying requirements: precisely what C2 deficiencies are being addressed by text-based chat tools? Or, from a bottom-up perspective: what capabilities do text-based chat tools bring to the war fighter? In this study, a broad set of use-cases is employed to further refine why operators use chat, based on how they apply chat to their specific combat problems. These use cases include ongoing combat operations in ENDURING FREEDOM, counterinsurgency operations in IRAQI FREEDOM, and disaster relief operations with Joint Task Force-Katrina. The focus of this study is on establishing operators' perceived requirements in light of the current capabilities delivered by the existing text-based chat tools. From these "reverse-engineered" requirements, future work is proposed to establish these communication capabilities in next-generation C2 systems.

**KEYWORDS:** Chat, Text Chat, Text-Based Chat, Requirements Development, Joint Chat Requirements, Command and Control, C2, Synchronous Communication, Real-Time Communication, Capability Gaps, Capabilities Based Assessment, Reverse-Engineered, Systems Engineering, FORCenet, TRIDENT WARRIOR, TW05

### IMPLEMENTATION OF A MODULAR FLY AWAY KITS (FLAK) FOR COMMAND, CONTROL, COMPUTER, COMMUNICATIONS, INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (C4ISR) IN ORDER TO COUNTER ASYMMETRIC THREATS IN THE COALITION RIVERINE AND MARITIME THEATRES

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This research analyzes the design and implementation of a Maritime Command, Control, Computer, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR) fly away kit (FLAK) in order to combat asymmetric threats in the coalition maritime environment. This FLAK is modular, adaptable, scalable, and secure end-to-end, composed of routable networks, and built entirely from commercial, off-the-shelf technologies (COTS). Basing measures of effectiveness (MOE) on the recently published Quadrennial Defense Report (QDR) and the Numbered Fleet Commanders Communication Message, these kits are tested with the goal of fulfilling thirteen of the fifteen high priority short-falls in the modern United States CIV-MIL and Coalition Forces' abilities to conduct multiple missions in the current brown (riverine), green (littoral), and blue (deep water) operational theatres.

The Maritime FLAK is designed with the intent of increasing the U.S. forward presence and extending the C4ISR into restricted maritime theatres. Since U.S. forces cannot intervene directly into regions like the Straits of Malacca, but can support coalition forces through advisors and technological adaptations, modular solutions to extend C4ISR into these maritime territories are needed. Furthermore, due to the adaptability and scalability of the technologies to be implemented into the maritime FLAK, these completed kits can be used by the recently formed Naval Expeditionary Combat Command (NECC) in current operations in the Global War on Terrorism.

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## SYSTEMS TECHNOLOGY

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**KEYWORDS:** IEEE 802.16, Wireless, Maritime Security, Riverine, NECC, GWOT, IEEE 802.11, VBSS Integrated Sensors, TCP/IP, MANET, FLAK, Radio-WAN, Small Boat, MIO, Interdiction, JC4I, ISR, Command, Control, Communications, Computers, Intelligence Surveillance, Reconnaissance

### **THE DESIGN AND IMPLEMENTATION OF A PROTOTYPE WEB-PORTAL FOR THE INTEGRATED MOBILE ALERTING SYSTEM (IMAS)**

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The Integrated Mobile Alert System (IMAS) is a mobile device message alerting system that provides a means for people to stay connected and receive information in a modality that is constantly available to them. The focus of this research is to develop a proof of concept for the common data format and common platform aspect of the proposed architecture. This project concentrates on the design characteristics of the IMAS-portal and server-side database. The thesis determines a way to aggregate, integrate, and sort different message formats in order to be easily displayed on a variety of mobile devices according to user profiles. It demonstrates that a web-portal written in PHP script supported by a relational database is a good configuration for IMAS. Additionally, a proof of concept system that converts messages into disseminated mobile alerts is presented. This thesis marks the founding steps in developing the IMAS.

**KEYWORDS:** Database Technology, Web Design, Mobile Device Technology, Mobile Alerts

### **ASSESSING THE POTENTIAL VALUE OF FORCENET TECHNOLOGIES WITHIN THE JOINT FORCES MARITIME COMPONENT COMMAND (JFMCC) PLANNING PROCESS USING THE KNOWLEDGE VALUE ADDED METHODOLOGY**

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In the FORCENet Functional Concept document published by the Chief of Naval Operations and the Commandant of the Marine Corps, the leaders of the U.S. Naval forces called for the development of “adaptive, distributed networks of commanders, staffs, operating units, supporting organizations, sensors, weapons and other equipment interacting with one another on an underlying infrastructure, as well as the associated command and control policies, concepts, organizations... to allow them to interact.” Posed to invest in the development of the FORCENet architecture, the Navy and Marine Corps require a means of analysis to determine the value of information technologies prior to development and acquisition. The Knowledge Value Added (KVA) methodology can provide the decision makers with quantitative tools to make informed and accurate decisions in the acquisitions process of information technologies within the FORCENet Functional Concept framework. Historically, these decisions were based on costs, schedule, and capabilities, with the emphasis on cost.

A Proof of Concept analyzing the Joint Forces Maritime Component Command (JFMCC) Planning Process is developed to demonstrate the utility of the KVA method. This analysis demonstrates the current inefficiencies within the process, and the potential value of notional information technologies that could be developed to support the planning process.

**KEYWORDS:** Knowledge Value Added, KVA, Planning Process, Return on Investment, ROI, Information Technology, IT, FORCENet, Joint Forces Maritime Component Commander, JFMCC, Trident Warrior

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# SYSTEMS TECHNOLOGY

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## INTEGRATING NAVAL SURFACE FIRE SUPPORT INTO AN IMPROVED JOINT CLOSE AIR SUPPORT ARCHITECTURE

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During recent campaigns in Kosovo, Afghanistan, and Iraq, increased emphasis has been placed on Close Air Support (CAS) for forces conducting unconventional operations with small, specialized units, as well as conventional operations at the brigade or division level. Because of the proximity to friendly troops, the need for successful integration of forces during CAS missions is critical. The effectiveness of the joint forces conducting Joint Close Air Support (JCAS) can be measured by the success or failure of the Command and Control (C2) process. Situations often occur in which forward air controllers (FACs) from one service integrate into the structure of another service, yet still report to their own leadership. Many non-interoperable communications systems are used, further adding to the confusion. This thesis analyzes the effectiveness of current Joint Close Air Support doctrine in providing the guidelines necessary for the warfighter at all echelons to plan, prepare, and execute integrated close air support missions seamlessly when operating in a joint environment. Themes that hamper the ability to efficiently employ command and control (C2) to provide close air support to the Ground Combat Commander are examined. Finally, Naval Surface Fire Support is studied to determine its place in the JCAS architecture and where, within that architecture, it should be implemented. The analysis of case studies involving situations in which JCAS was not used effectively reveal that, though there has been significant progress made in revising Joint CAS doctrine, weaknesses still exist. Joint doctrine must keep pace with emerging technology, but for that doctrine to remain relevant, warfighters at all levels must know it, use it, and provide feedback when it does not work so future iterations can mature and flex with the force.

**KEYWORDS:** Close Air Support, CAS, JCAS, Naval Surface Fire Support, JCAS Doctrine

## TEST AND EVALUATION OF MESH DYNAMICS 802.11 MULTI-RADIO MESH MODULES IN SUPPORT OF COALITION RIVERINE OPERATIONS

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**Master of Science in Systems Technology (Command, Control and Communications (C3))-June 2006**

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**Second Reader: R. Mitchell Brown, III, Naval War College, Monterey Program Office**

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The Coalition Operating Area Surveillance and Targeting System (COASTS) program is a joint project between the Naval Postgraduate School and the Royal Thai Armed Forces (RTARF). The program focuses its research on Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) uses for commercial, off-the-shelf (COTS), state-of-the-art, rapidly scaleable airborne and ground communications equipment, including various wireless network technologies. This research is being conducted in partnership with the RTAF to develop a network and associated devices and applications that potentially may help suppress drug trafficking in the northern Thailand border regions.

Commensurately, the U.S. Navy is taking the lead on the Global War on Terror (GWOT) in coalition Maritime Security Operations and riverine warfare operations. With the formation of the new Naval Expeditionary Combat Command (NECC) and its new Riverine Warfare Group, the Navy takes on this role starting in January 2007, and could benefit from this research.

This thesis focuses on testing and evaluating the overall performance of the MeshDynamics Multiple-Radio Mesh Modules, operating in the 802.11 wireless frequency spectrum. These modules are key building blocks of meshed networks that provide coverage over an area where riverine and coastal operations are being conducted. The network provides an information source and communications backbone for maritime, ground, and air assets.

**KEYWORDS:** C4ISR, Maritime Security Operations, IEEE 802.11 Technology, Wi-Fi, Riverine Warfare, Wireless Meshed Networks

**AUTONOMOUS TIME-FREQUENCY CROPPING AND FEATURE-EXTRACTION  
ALGORITHMS FOR CLASSIFICATION OF LOW PROBABILITY OF INTERCEPT (LPI)  
RADAR MODULATIONS**

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Three autonomous cropping and feature extraction algorithms are examined that can be used for classification of low probability of intercept (LPI) radar modulations using time-frequency (T-F) images. The first approach, Erosion Dilation Adaptive Binarization (EDAB), uses erosion and a new adaptive threshold binarization algorithm embedded within a recursive dilation process to determine the modulation energy centroid (radar's carrier frequency) and properly place a fixed-width cropping window. The second approach, Marginal Frequency Adaptive Binarization (MFAB), uses the marginal frequency distribution and the adaptive threshold binarization algorithm to determine the start and stop frequencies of the modulation energy to locate and adapt the size of the cropping window. The third approach, Fast Image Filtering, uses the fast Fourier transform and a Gaussian low-pass filter to isolate the modulation energy. The modulation is then cropped from the original T-F image and the adaptive binarization algorithm is used again to compute a binary feature vector for input into a classification network. The binary feature vector allows the image detail to be preserved without overwhelming the classification network that follows. A multi-layer perceptron and a radial basis function network are used for classification and the results are compared. Classification results for nine simulated radar modulations are shown to demonstrate the three feature-extraction approaches and quantify the performance of the algorithms. It is shown that the best results are obtained using the Choi-Williams distribution followed by the MFAB algorithm and a multi-layer perceptron. This setup produced an overall percent correct classification (Pcc) of 87.2% for testing with noise variation and 77.8% for testing with modulation variation. In an operational context, the ability to process and classify LPI signals autonomously allows the operator in the field to receive real-time results.

**KEYWORDS:** Choi-Williams, Wigner-Ville, BPSK, Time-Frequency, Autonomous, LPI, Feature Extraction, Multi-Layer Perceptron, Radial Basis Function



**MASTER OF ARTS**

**National Security Affairs  
Security Studies**



# MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

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## **WEINBERGER-POWELL AND TRANSFORMATION: PERCEPTIONS OF AMERICAN POWER FROM THE FALL OF SAIGON TO THE FALL OF BAGHDAD**

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**Master of Arts in National Security Affairs-June 2006**

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Throughout American history, policymakers have struggled with the use of American military power. The Limited War argument holds that the use of force needs to remain an option to support American diplomacy. The Never Again argument, meanwhile, holds that the use of American military power should be undertaken only in the face of threats against vital national interests. The most influential Never Again argument has been the 1984 Weinberger Doctrine, later expanded to the Weinberger-Powell Doctrine, which sought to limit the use of American military power. After the Vietnam War and the 1983 Marine barracks bombing, the Weinberger-Powell Doctrine was ascendant over Limited War arguments like Secretary of State George Schultz's case in favor of the limited use of American military force against targets of less than vital interest. Between the 1991 Gulf War and the 2002 invasion of Iraq, however, the Weinberger-Powell Doctrine lost much of its influence with American policymakers. This thesis establishes a link between the loss of influence by the Weinberger-Powell Doctrine and the rise in the utility of force based on improvements in military technology and doctrines, leading to a broadening of policy objectives that would not have been possible during the Cold War.

**KEYWORDS:** Caspar Weinberger, Colin Powell, Transformation, force, Limited War, 1991 Gulf War, Panama, Afghanistan, Lebanon, Doctrine, Network-Centric, Precision-Guided Munitions, AirLand Battle, Active Defense

## **POLISH DEFENSE POLICY IN THE CONTEXT OF NATIONAL SECURITY STRATEGY**

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**Master of Arts in National Security Affairs-June 2006**

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Since the turn of this century, stability on the European continent has depended to a large degree on political-military cooperation among European countries, and the establishment of common goals in order to eliminate current threats and risks such as terrorism. As far as Poland is concerned, its priority is to be an active leader in improving common security policy within the boundaries of the European Union (EU) and the North Atlantic Treaty Organization (NATO). Polish security policy and strategy is shaped by its geographical location, which places Poland in NATO's main strategic area, opposite the Russian Federation and Belarus. In other words, Poland sees itself as the eastern "edge" of NATO's area and as a "front-line" country. This motivates Poland to support NATO's further enlargement to the east because Warsaw understands that it is a primary key to stability in Europe and has a responsibility to support NATO activities in this region. Thus, this thesis analyzes the character of Polish Defense Policy after integration into NATO and EU, and the impact this policy has on national interests. It specifically focuses on ongoing efforts to adjust defense policy and strategy to meet contemporary demands through political-military cooperation and dialogue with allies.

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## NATIONAL SECURITY AFFAIRS

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**KEYWORDS:** Poland, United States, European Union, National Security Policy, Defense Policy, NATO

### **CULTURAL TRENDS AND THE IMPLICATIONS FOR THE TRANSFORMATION OF THE BUNDESWEHR**

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The aim of this thesis is to show that Germany has to enhance its efforts to integrate and transform national forces into European armed forces, while retaining the core values of democracy amid a growing emphasis on cultural and ideological conflict. This thesis develops a model that maps out the political consequences of transformation and puts it into an educational framework for practical application in the ranks of the German armed forces and possibly beyond.

Above all, it is about the integration of different national military cultures and traditions that are based on different national ideas of soldiering, as well as the altered meaning of soldierly service in the period since 1989. However, when looking at the present day German armed forces, the lack of attention to cultural transformation is problematic. The neglect of the dimensions of society, politics, and soldiers can cause a danger to the ongoing transformation of the Bundeswehr, not the least because of past problems in German arms and the stresses and strains now faced by those armies most directly engaged in combat in Iraq and Afghanistan. Taking the goals of the transformation of the Bundeswehr into account, this thesis illustrates why the German armed forces still have to intensify their efforts for European military integration in the cultural dimension of society.

**KEYWORDS:** Transformation, Culture, Security, Trends, Education, “Innere Führung”

### **REALIGNMENT OF UNITED STATES FORCES IN THE PACIFIC: WHY THE U.S. SHOULD PURSUE FORCE SUSTAINMENT TRAINING IN THE REPUBLIC OF THE PHILIPPINES**

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**Master of Arts in National Security Affairs-June 2006**

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**Second Reader: Raymond Roll, Department of National Security Affairs**

This thesis argues that the United States should attempt to increase its access to training opportunities in the Republic of the Philippines. In 2003, the Pentagon outlined plans that called for the realignment and transformation of U.S. forces across the globe. The planned realignment of U.S. forces in Northeast Asia necessitates access to new training areas in Southeast Asia. This thesis identifies why the U.S. should focus its efforts in the Philippines by identifying: 1) why U.S.-Philippine political and military relations have warmed over the past 15 years, as well as what both countries hope to gain from this positive trend; 2) how the expansion of existing, and the establishment of new, training opportunities in the Philippines will enhance U.S. force capabilities while also fostering the development of the Armed Forces of the Philippines (AFP) into a more capable, professional armed force; and 3) ways to mitigate possible fears of an increased U.S. presence in the area by focusing on the benefits which will arise from such a presence. Ultimately, U.S. access to training areas in the Philippines will add stability both to the Philippines and Southeast Asia as a whole, while simultaneously aiding in the Global War on Terror.

**KEYWORDS:** Philippines, Training, Military Professionalism, Global War on Terror, U.S. Realignment, Regional Stability, Internal Relations

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## NATIONAL SECURITY AFFAIRS

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### UNITED STATES MILITARY PRESENCE IN CENTRAL ASIA: IMPLICATIONS OF UNITED STATES BASING FOR CENTRAL ASIAN STABILITY

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**Master of Arts in National Security Affairs-June 2006**

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

This thesis examines the United States policy for establishing overseas military bases, particularly in Central Asia. The major transformational trends in improving United States military capabilities over the past two decades, and the changing international security environment, have shaped the way American leaders focus on their global military posture strategy. Immediately following the September 11, 2001, terrorist attack, the United States moved quickly to establish a presence in Uzbekistan and Kyrgyzstan, and after the defeat of the Taliban, several bases became available in Afghanistan. Soviet military influence in Central Asia is examined and compared to current United States policies and procedures. While military bases still maintain several strategic advantages in terms of response times and maneuver, there needs to be an equally-sized effort to explore how these bases can provide stability. Achieving stability in Central Asia will require the United States to move away from the conventional ideology of basing, which it has used for many years, and to embrace policies and procedures that can meet the military mission and gain the trust of the host country.

**KEYWORDS:** Military Presence, Bases, Overseas Basing, Central Asia, Manas Air Base, Bagram Air Base, Karshi Kanabad Air Base, Sustained Presence

### CRISIS IN BALUCHISTAN: A HISTORICAL ANALYSIS OF THE BALUCH NATIONALIST MOVEMENT IN PAKISTAN

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**Master of Arts in National Security Affairs-June 2006**

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**Feroz H. Khan, DoD Contractor**

Since January 2005, Pakistan's Baluchistan province has been embroiled in a rash of violence that threatens to deteriorate into civil war. Is this recent violence yet another recurrence of state-periphery tensions, or is it a qualitatively new phenomenon that threatens U.S. and Pakistan interests in the region? This thesis analyzes the historical causes of Baluch political violence in order to determine why Baluchistan is again enmeshed in bloody conflict. Violence in Baluchistan historically has been the product of several factors: a fiercely independent Baluch people that eschew outside interference, the lasting legacy of British policy, mismanagement by ruling Pakistani regimes, and historical grievances that have allowed Baluch leaders to mobilize support for their nationalist cause. The argument of this thesis, however, is that the particular timing of the most recent surge of violence in Baluchistan is the result of a change in the relationship between the central government and Baluchistan brought about by the province's growing strategic significance. While the United States currently views the conflict in Baluchistan as an internal matter, growing violence and continued instability in a region where the presence of the Taliban and Al Qaeda is widespread makes this a crisis worthy of attention.

**KEYWORDS:** Pakistan, Baluchistan, Gwadar, Nationalism, Ethnic-Nationalism, Baluch Nationalism, Ayub Khan, Zia ul-Haq, Zulfikar Ali Bhutto, Pervez Musharraf

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# NATIONAL SECURITY AFFAIRS

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## SEA PIRACY IN SOUTHEAST ASIA: IMPLICATIONS FOR COUNTERING MARITIME TERRORISM IN THE UNITED STATES

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Sea piracy has infested the seven seas throughout history. In modern times, the United States has paid little attention to piracy because the nation's isolated vastness has protected the shipping industry from maritime crime. But the events of 9/11 have changed the lens through which America views security. This thesis investigates modern day piracy and links between piracy and terrorism in order to determine implications for U.S. maritime security strategy. Specifically, the maritime environment in Southeast Asia and associated maritime security policies are researched because over the past 12 years, nearly fifty percent of the world's sea piracy has occurred in that region. The U.S. maritime security strategy is also evaluated so that informed policy recommendations can be formulated.

**KEYWORDS:** Sea Piracy, Southeast Asia, Maritime Security, Maritime Terror

## UNITED STATES' COUNTER-NARCOTICS POLICIES TOWARDS BURMA, AND HOW THE ILLEGAL MYANMAR REGIME IS MANIPULATING THOSE POLICIES TO COMMIT ETHNIC GENOCIDE

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U.S. counter-narcotic policies towards Burma have possessed a singular-focus. In other words, they have been based on the traditional bilateral triumvirate strategies of eradication, education, and interdiction. Eradicate the crops used to produce illicit narcotics, interdict the flow of illicit drug traffickers, and educate the general population on the dangers of continual drug usage. However, in the country of Burma, there are other U.S. policies that also have a singular focus, which have undermined the effectiveness of these policies.

Since the Burmese military regime's brutal suppression of the pro-democracy movement in 1988, the U.S. has severed all economic relations with the country. The Burmese economy, which was already far from stable, fell into a downward spiral as a result of these U.S.-led policies. This did not result in a democratic transition. Over seventeen years since these economic sanctions have been in place, the U.S. has not achieved a peaceful regime change in Burma. Furthermore, the attempts to remove the significant flow of illicit narcotics from the country have failed as well.

The reason these two singular-oriented policies have failed is that they are targeted at a country much more complex than these strategies have been designed to handle. First of all, there are 135 ethnicities in Burma, while only a small portion of the Burman population maintains political and economic control. Although this would result in ineffective policies with little collateral impact, the ruling Tatmadaw regime has manipulated these policies to commit ethnic genocide upon the ethnic minorities within their territory. Unless a re-assessment of these policies is undertaken by the U.S. and its allies, the only result of their policies will be the elimination of millions of ethnic minorities in this totalitarian state.

Therefore, the U.S. must re-assess its position of isolating the Myanmar regime, and focus on a policy of engagement. Only if a structured and progressive incentive policy of economic development is created in conjunction with the regime can the separate triumvirate policies of counter-narcotics against the ethnic minorities in Burma become effective.

**KEYWORDS:** Burma, Myanmar, Narcotics, Opium, Heroin, Minority, Insurgent, Southeast Asia, ASEAN, UN, United Nations, United Nations Security Council, Shan, Karen, Wa, Yaa Baa,

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## NATIONAL SECURITY AFFAIRS

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Methamphetamine, Illicit, Drug, DEA, Thailand, U.S., China, Laos, SSA, UWSA, KNLA, SPDC, NLD, Democracy, Sanctions, Aung San Suu Kyi

### **BROTHERS OR RIVALS? IRAN AND THE SHI'A OF IRAQ**

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This thesis examines the loyalty of the Shi'a of Iraq. While some Sunni Arab leaders have recently accused the Shi'a of Iraq of pledging loyalty to Iran, in fact the Iraqi Shi'a are loyal to their own nation. The Shi'a have developed different identities in Iran and Iraq due to different historical legacies and patterns of conversion. Modern religious-based political activists in the two nations have responded to their different circumstances with different policies. Ba'athist Party programs that secularized Iraqi society collapsed in the wake of events in the 1980s and 1990s. Old sources of authority reemerged among the Iraqi Shi'i community in their wake. These sources, primarily religious and tribal leaders, asserted themselves after the American invasion overthrew Saddam Hussein. Shi'i leaders, such as Sadr and Sistani, have sought not to work in the interests of Iran, but in what they perceive as the interest of their own constituents. They share many interests with Iran, but have been willing to work with Americans. This thesis urges American leaders to see the Shi'a of Iraq as they are, not as Sunnis Arab leaders portray them, in order to avoid alienating the Shi'a and thus pushing them further toward Iran.

**KEYWORDS:** Iraq, Iran, Islam, Islamism, Shi'a, Shi'i, Sunni, Insurgency, Democracy

### **CENTER OF GRAVITY IN THE ASYMMETRIC ENVIRONMENT: APPLICABLE OR NOT?**

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The military concept of a Center of Gravity (COG) in conflicts, introduced by Carl von Clausewitz in the 1820s, is now an element of numerous military doctrines that planners draw on in designing strategies for winning wars. Over the last 25 years, the concept has become increasingly central to U.S. warfare doctrine. The world has changed a great deal since the introduction of COG. And in today's asymmetric environment, in which non-state actors use unconventional tactics, it is becoming extremely difficult to apply the COG concept. The primary reason for this difficulty is that non-state actors do not operate as a unitary body, which makes it difficult to target a COG that would lead to a decisive victory. The purpose of this thesis is to analyze both conflicts in which state-sanctioned militaries' applied the COG concept and conflicts in which non-state actors used asymmetric tactics. The thesis attempts to determine the applicability of COG in an asymmetric environment. If the Center of Gravity concept is determined inapplicable, then the U.S. military must either redefine it or create a new means to deal with this new type or warfare.

**KEYWORDS:** Center of Gravity, Conventional Warfare, Asymmetric Tactics, Strategy, Terrorist Tactics

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### **STABILITY IN PAKISTAN: REALIZING THE VISION OF ENLIGHTENED MODERATION**

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The purpose of this study is to evaluate the public policy and programs of Pakistan's Pervez Musharraf administration, and in light of Pakistan's unique history and culture, to offer recommendations for Pakistan and the United States for the successful realization of Musharraf's "Enlightened Moderation" plan for a successful, and stable Pakistan.

In its nearly 60 years of independence, Pakistan has never fully established an identity for itself that has not been restructured by subsequent administrations. The military is one of the main elements of the federal political machine, and as such has assumed control of the government no less than four times in those 60 years – the first occurred shortly after independence when Pakistan's founding father died before a government could be structured and formed. The current military ruler has stated his intention for a lasting establishment of a moderate and successful Muslim state. With the spread of radical militant Islam throughout the region and the United States' War on Terror as his constraints, President General Pervez Musharraf finds himself in a position where success now is crucial, not optional.

**KEYWORDS:** Pakistan, Islam, Politics, Musharraf, Enlightened Moderation, Pervez Musharraf, Secularization and Modernity

### **HIV/AIDS PREVENTION IN ZAMBIA: A PRELIMINARY STUDY OF OBSTACLES TO BEHAVIOR CHANGE IN THE COPPERBELT**

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Since the 1980s, HIV prevention programs around the world have continuously expanded in attempts to meet challenges in the fight against HIV/AIDS. These programs are generally based on primary prevention, which uses Information Education and Communication (IEC) to modify individual behavior. In Africa, as in many underdeveloped countries, various country-specific studies report that a majority of the population is knowledgeable about HIV/AIDS and how to prevent transmission. Yet, while studies show a relatively strong link between education and behavior modification in developed countries, that link appears to be much weaker in less developed regions, including Africa. The literature identifies social and economic factors, especially gender inequalities and poverty, as significant obstacles to behavior change. This thesis assesses the impact of these factors in the Copperbelt region in Zambia, finding significant evidence that both social and economic factors operate as fundamental obstacles to behavior change. These findings suggest that HIV interventions need to go beyond IEC to deal with broader community development challenges. Gender imbalances play a particularly large role, and the findings suggest a desperate need for gender specific interventions targeting men.

**KEYWORDS:** HIV/AIDS, Prevention, Copperbelt, Zambia, Sub-Saharan Africa, Obstacles, Behavior Change, Economic, Social, Gender, Interventions, Program Design, Implementers

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## **THE PEOPLE'S REPUBLIC OF CHINA'S ECONOMIC GROWTH AND FOREIGN POLICY**

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This thesis explores whether a causal relationship exists between the People's Republic of China's foreign policy and in its economic policy. Specifically, it explores how China's overall economic policy has led it to become involved in countries that are considered political pariahs by many countries, but that have established or potential petroleum resources to which China hopes to gain exclusive or at least first chance rights. Concentrating on those relationships, the thesis explores the extent to which Beijing has acted on the international political stage to protect those countries from international pressure and to preserve their political status quo because of China's economic ties with those countries. In three case studies focused on Iraq, Iran, and the Sudan, the thesis finds that Beijing's overall foreign policy is little affected by its economic ties with those countries. In each case, the thesis finds that China's economic ties are more important to Iraq, Iran, and the Sudan than to Beijing, and that such ties are small among overall Chinese economic concerns. Additionally, the thesis finds that Beijing defends these countries in international forums based on longstanding foreign policy considerations of upholding sovereignty and not on economic policy.

**KEYWORDS:** People's Republic of China, Iraq, Iran, Sudan, Economic Policy, Foreign Policy

## **AN UNMASTERED PAST: LATVIA AND RUSSIA AFTER NATO AND EUROPEAN UNION**

**(EU) ENLARGEMENT: BILATERAL ISSUES OF STATECRAFT 2003-2006**

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Latvian-Russian bilateral relations must be understood in their historical framework. Relations were expected to improve after the enlargement of NATO and the European Union in 2004. These expectations, however, were not fulfilled and changes within the international system left no significant influence on the state of affairs in Latvian-Russian relations. This thesis examines the main theoretical paradigms of international relations that influence interstate relations, as well as the importance of perception of antagonistic policies. The centerpiece of these relations is the problem of the border treaty, which includes several other issues, such as recognition of occupation, state continuity of Latvia, and eventually, the problem of the Slavic population in Latvia. Therefore, the central consideration in this thesis is to explain the formulation and implementation of foreign policies of both states in the context of agendas of political elites and society.

The thesis also touches upon the future of Latvian-Russian relations, claiming that the current lack of incentives does not predict an optimistic scenario, namely, normalization of bilateral relations. Rather that both states will maintain the substantial level of animosity and will try to use situation on the international level to acquire supporters of their policies.

**KEYWORDS:** Republic of Latvia, Russian Federation, Border Treaty, Bilateral Relations, World War II, Waffen SS, NATO, European Union, Abrene District, Occupation, State Continuity, International Relations, Foreign Policy

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# NATIONAL SECURITY AFFAIRS

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## OPERATIONALIZING DISSUASION

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Dissuasion is a strategy for persuading adversaries to seek acceptable alternatives to building threatening capabilities or adopting hostile intentions towards the United States. Dissuasion is a framework for organizing strategy directed at dealing with future threats. As such, it compliments other traditional national strategies (such as deterrence or coercion), and uses deterrence, coercion, and even appeasement, to meet overall policy goals.

Dissuasion as a strategy was not formally articulated until it appeared in the 2001 Quadrennial Defense Review. Despite dissuasion's comparatively recent recognition, its historical use by states attempting to influence geopolitical rivals has been frequent. Dissuasion is stated as a primary strategy in the capstone national security documents of the United States, but clear guidelines on how dissuasion can be implemented are lacking.

This study expands the understanding of dissuasion as a strategy, examining three historical instances where it was used by states seeking to influence the behavior or military force structure building of other states, bringing dissuasion out of the realm of theory and into the real-world. Tools and procedures are described in order to "operationalize" dissuasion, the role of naval forces in dissuasion is scrutinized, and the vital intersection of strategic culture and dissuasion is examined.

**KEYWORDS:** Dissuasion, Strategy, Deterrence, Naval Strategy, Coercion, Non-Proliferation, Weapons of Mass Destruction, Anglo-German Relations, Libya, Baltic, National Security Policy

## HIZB UT-TAHRIR: A THREAT BEHIND A LEGAL FAÇADE?

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Hizb ut-Tahrir is a transnational Islamic fundamentalist group that operates in more than forty countries, with main emphasis in Europe, the Middle East, and Asia. The group claims to be a political party that proceeds with non-violent means and whose ideology is Islam. Its objectives are strictly political, and its main goal is to topple an existing regime to resurrect the caliphate with structures and conditions similar to the ones of early seventh-century (C.E.) Islam. The proposed Islamic state will be responsible for transforming society in a united Ummah, and for spreading the word of Islam throughout the world. Hizb ut-Tahrir (HT) rejects modern, secular state structures and democracy as something "man-made," humanly derived, and "un-Islamic," and therefore does not participate in any secular electoral process. However, HT does not reject modern technology and its advantages.

This research focuses on Hizb ut-Tahrir, its objectives, and its preferences as the group adjusts its strategies according to the political environment in which it is embedded. The thesis investigates how HT often uses a legal framework to spread its Islamist ideology and how this multifaceted phenomenon is context specific. The conclusion addresses policy recommendations that reflect area- and context-related specifics with a special focus on the group's major threat—its ideology.

**KEYWORDS:** Hizb ut-Tahrir, Hizb al-Tahrir, HT, HuT, HaT, Islamic Fundamentalism, Caliphate, Transnational Group, Islam, Political Islam

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### **THE IRANIAN NUCLEAR STANDOFF: THOSE WHO CAN HELP, WON'T**

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In the face of Tehran's vitriolic rhetoric and outright refusal to cooperate with the International Atomic Energy Agency, why do Russia, China, and India refuse to support the United States and the EU-3 in their efforts to curtail Iran's pursuit of a complete and indigenous nuclear fuel cycle?

Russia's motivations stem from its desire to establish itself as a counter to American hegemony and also to maximize its significant financial relationship with Iran. China's booming economy is dependent on its vast manufacturing infrastructure, which is increasingly dependent on Middle Eastern oil for its energy needs. Thus, China is unlikely to take a hard stand on Iran. India's energy demands are growing almost as quickly as those of China and Iran is a vital source of natural gas and oil for India. Also, Iran can be seen as a test case in India's desire to maintain an independent foreign policy.

Containing Iran to the detriment of relations with these countries is not a path the United States should follow. U.S. foreign policy should support a verifiably peaceful nuclear program in Iran, with defined and unambiguous penalties should it come to light that the technology is diverted towards a military application.

**KEYWORDS:** Iran, Nuclear Program, UNSC, IAEA

### **TOURISM IN PERU: THE MISSING STRATEGY FOR ECONOMIC AND SOCIAL DEVELOPMENT**

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In this thesis, the possibilities of tourism as a strategy for economic and social development in Peru are presented. Through the examination of previous governments, beginning with the Belaunde Administration in 1963, the obstacles that Peru has faced in route to development are identified. Identification of the predominant issues at hand, unemployment, poverty, and inequality, allows for further analysis of the policies implemented to stabilize the economy as well as provides immediate solutions for the above mentioned points of concern. It becomes clear that while the country is rich in resources, beyond natural resources such as crude oil and minerals, the promotion and enhancement of the tourism industry has rarely been used as a means of earning revenue. While there are a number of options to consider with regard to developmental strategies, the tourism industry presents definite opportunities for growth. These benefits are closely examined in this thesis, demonstrating how much Peru has to offer, not only to tourists who seek to broaden their cultural knowledge, but most importantly, to the Peruvian people by way of a robust tourism sector.

**KEYWORDS:** Tourism, Peru, Economic and Social Development

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# NATIONAL SECURITY AFFAIRS

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## **AVOIDING DOWNWARD SECURITY SPIRALS IN NORTHEAST ASIA: THE GRADUAL TRANSITION TO A MILITARILY “NORMALIZED” JAPAN**

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The world is on the verge of a dramatic shift in security relations in Northeast Asia. With a “rising China” and a Japan emerging as a “normal” military power by revising the pacifist clause of its constitution (Article 9), many analysts argue that the new century may bring with it increased instability to the region. With this forecast in mind, this thesis explores how the United States should approach a militarily “normalizing” Japan. The primary questions analyzed are: 1) will the current ad hoc movement towards the revision of Article 9 (Renunciation of War Clause) be the impetus for a downward security spiral in Northeast Asia? 2) what should U.S. policy be towards the revision of Article 9?, and 3) should the United States push for further “normalization” and burden sharing in security relations? This thesis concludes that in order to ameliorate the security tensions in the region that are arising from the ad hoc revision of Japanese Article 9, the United States should implement three policy prescriptions which will increase the transparency and the time horizon associated with this dramatic shift in Japan’s military restraints. The first policy recommendation is that the United States should use its influence to persuade Japan to hold off revision of Article 9 until the 75th anniversary of the document’s enactment (3 May 2022). Second, to minimize Japan’s need to re-militarize, the United States should maintain its current force levels in the region leading up to the 2022 transition in order to provide continued stability in the region. Lastly, the United States should push for greater burden sharing by the Japanese; however, it should focus on a greater utilization of Japan’s ability to project “soft power.” Execution of these policy recommendations will help ease the fears of Japan’s apprehensive neighbors (China, North Korea, and South Korea).

**KEYWORDS:** Japan, Article 9, Japanese Constitution, Japanese Self-Defense Force, Normalization, People’s Republic of China, Sino-Japanese Relations, Korean-Japanese Relations, Japanese Foreign Policy, Japanese Security, U.S. Foreign Policy, Chinese Foreign Policy, Korean Foreign Policy

## **“ONE CHURCH, ONE PEOPLE, ONE EMPEROR” — STRATEGIC CHALLENGES FOR THE SERBIAN ORTHODOX CHURCH IN POST-MILOSEVIC SERBIAN SOCIETY**

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This thesis analyzes the Serbian Orthodox Church's place in post-Milosevic Serbian society. Specifically, the thesis explores the nature of the influence the Church sways within Serbia's on-going transformation into a liberal democracy. Leveraging Robert Putnam's work on civil society and social capital, and Ashutosh Varshney's work on associational networks, the thesis addresses two main questions. First, what is the nature of the Church's influence - does it seek to build bridges across societal sectors or does it seek to exclude others by bonding together an autonomous societal group consisting of the Church and its faithful? Second, what are the implications of this behavior for Serbia's integration into Euro-Atlantic institutions? Using a blend of case studies (Croatia, Russia), historiography (Serbia), and textual analysis, this study argues that the Serbian Orthodox Church has exhibited both bridging and bonding tendencies with other sectors of civil society, though bonding behavior prevails. The European Union and others can mitigate these bonding inclinations through actions such as granting funds to increase charity work and acknowledging the fact that the Church will continue its role within Serbian society/identity for a long time. These actions should allow the more moderate and bridging elements within the Church to further develop.

**KEYWORDS:** Serbia, Orthodoxy, Serbian Orthodox Church, Croatia, Catholic Church, Russia, Russian Orthodox Church, European Union, Nationalism, Civil Society, Social Capital, Bridging, Bonding

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### HAS UKRAINE'S PATH TO DEMOCRACY IMPROVED FROM INDEPENDENCE TO THE ORANGE REVOLUTION?

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This thesis seeks to identify whether Ukraine is transitioning to a democracy from an authoritarian regime after the breakup of the Soviet Union and if so, to measure Ukraine's democratic progress in applying traits of democratization from the 1990 parliamentary elections to the 2004 Orange Revolution. A free and fair electoral process involving multiple political parties, genuine power resident with elected officials, and executive power both constrained constitutionally and held accountable by other government branches (i.e., the Verkhovna Rada and the judiciary), will be used to measure Ukraine's democratic transition. Historical analysis of democracy's progress is examined during the presidencies of Leonid Kravchuk (1991-1994), Leonid Kuchma (1994-2004), and Viktor Yushchenko (2004-present), discerning whether democracy has progressed or diminished over the past 15 years. Ukraine's democratic establishment may be the catalyst to spread democracy throughout the region.

**KEYWORDS:** Ukraine, Russia, Democratization, Freedom House, Democracy, Free Election Process, Constitution of Ukraine, Leonid Kravchuk, Leonid Kuchma, Viktor Yushchenko, Orange Revolution, OSCE, ODIHR, Verkhovna Rada



# **MASTER OF ARTS IN SECURITY STUDIES**

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## **THE CASAMANCE SEPARATISM: FROM INDEPENDENCE CLAIM TO RESOURCE LOGIC**

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In the 1980s, Senegalese ethnic harmony was tarnished by the emergence of the Mouvement des Forces Démocratiques de la Casamance (MFDC). The major demand of this organization was the independence of Casamance, a southern province of Senegal. In the initial years of the movement (1980-1990), the MFDC capitalized upon the grievances of the local populations and received support from them. In the first half of the 1990s, it began to receive substantial support from neighboring countries and in response came to rely less upon the support of local constituents. It escalated the violence not only against the state, but also against local populations, which reinforced its growing dependence upon external patrons rather than popular support. In the 1990s, the government of Senegal worked to cut off both external and internal support to the MFDC by improving its relations with the neighboring countries and by practicing a politics of “charm” vis à vis the local populations. In response, the MFDC has become engaged in the illegal exploitation of natural resources. As the MFDC has shifted from one support base to another, it has pragmatically altered tactics and objectives. This demonstrated adaptability of the MFDC has important implications for the understanding of post-Cold War civil conflicts and for the governments’ efforts to resolve them. It suggests that the distinction between “greed” and “grievance,” which motivates much of the recent scholarly debate on ethnic conflict, is largely a false one, and that governments must address both in their efforts to resolve such conflicts.

**KEYWORDS:** Senegal, Casamance, Separatism, Secession, MFDC, Sources of Support, War Economy, Ethnic Conflict, Economic Agenda, Greed v. Grievance

## **UNTAPPED AIR FORCE RESOURCES FOR STABILIZATION AND RECONSTRUCTION OPERATIONS**

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This thesis reviews the potential contributions of the United States Air Force to stabilization and reconstruction operations. Specifically, the Air Force’s On-Scene Commanders Course and Air Force Mission Support Group Commanders are assessed as potential Air Force assets that could be employed in stabilization and reconstruction operations. This research determines the course’s ability to satisfy key needs identified in the post-conflict literature and whether the course would be useful for other U.S. agencies with responsibilities in post-conflict operations. Finally, this paper asks if Mission Support Group Commanders can provide critical skill-sets valuable in stability operations. This work assesses the applicability of these Air Force leaders’ duties for possible use in post-conflict operations by reviewing the Air Force’s Objective Wing Structure and duty histories of current and former Mission Support Group Commanders.

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**KEYWORDS:** Post-Conflict Reconstruction, Stabilization Operations, Training and Education, On-Scene Commanders Course, Universal Joint Task List, National Military Strategy, State Department Office of the Coordinator for Reconstruction and Stabilization, Department of Defense Directive 3000.05, National Security Presidential Directive 44, Air Force Mission Support Group, Air Force Combat Wing Organization Structure

### **UNGOVERNED SPACES: THE CHALLENGES OF GOVERNING TRIBAL SOCIETIES**

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This thesis addresses the efforts of different regimes to establish their authority over the Pashtun ethnic group. The Pashtun are at the heart of the conflict in Afghanistan, which also reaches into northwestern Pakistan. They provide both an important and current example of why “ungoverned spaces”—geographic regions beyond the reach of central authority—have become such an important topic among many of the world’s countries. People that exist within a sovereign state’s borders and outside the state’s authority present a potentially dangerous problem to both the state itself and the international community.

To address the challenges facing a state attempting to establish its authority over the Pashtun, this thesis identifies normative and organizational structures associated with rural Pashtun tribes and discusses how these factors impede the creation of central state authority. These factors are applied to three cases—concerning Britain, Pakistan, and the Soviet Union—which involved a modern government’s efforts to establish its authority over the Pashtun. In almost every case, the state failed when it either misunderstood the importance of these structural factors or willfully ignored them to pursue other interests. The most successful case occurred when the government of Pakistan focused on integrating the Pashtun through providing education, transportation, and health services. The intent was to bring the Pashtun into Pakistan’s mainstream society. Unfortunately, this effort was short-lived due to the Soviet invasion of Afghanistan.

Looking beyond the Pashtun case, the research in this thesis suggests that policies focused purely on suppression, isolation, or accommodation are destined to fail in establishing state authority. The common failing of these three policies occurs when the state fails to understand the difference between establishing order and establishing authority. Most often, a policy focused on a give and take relationship with a tribe, leaning slightly towards more giving than taking, appeared to work best. Finally, the state must seriously consider its capacity to expand its authority—the lower the capacity, the longer it will take and the more accommodating (but not purely accommodating) the state must act.

**KEYWORDS:** Pashtun, Governance, Tribal Societies, Segmentary Societies, State Authority

### **U.S. FOREIGN POLICY FOR NORTH KOREA: FLEXIBILITY IS THE BEST POLICY**

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The North Korean nuclear weapons program poses a challenge to stability in Northeast Asia. The United States’ foreign policy with North Korea takes a hard-line position and cannot solve this problem unilaterally. Support from the other countries in the region is needed. Solving this nuclear issue is only one piece of the stability challenge in this region.

North Korea’s nuclear program gained international attention when it signed the Nuclear Nonproliferation Treaty (NPT) in 1985, threatened to withdraw in 1993, withdrew in 2003, and stated it has a nuclear weapons capability in 2005. The Six-Party Talks were initiated with the goal of stopping and dismantling North Korea’s entire nuclear weapons program, and has had limited success. Previous negotiations between North Korea and the United States have ended with one party, usually North Korea,

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failing to uphold its part of the agreement. The Six-Party Talks may be successful, but may take decades. It comes down to the question of whether the United States is pursuing the best foreign policy toward North Korea? This thesis examines North Korea's nuclear program history, how it perceives itself and others, reviews the current U.S. policy, recommends a flexible policy, and proposes a method of implementation.

**KEYWORDS:** North Korea, Nuclear, Proliferation Security Initiative, PSI, Northeast Asia, Foreign Policy



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