



2006-12

# Compilation of thesis abstracts, December 2006

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# **Compilation of Thesis Abstracts**

## **December 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 December 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 *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:

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.

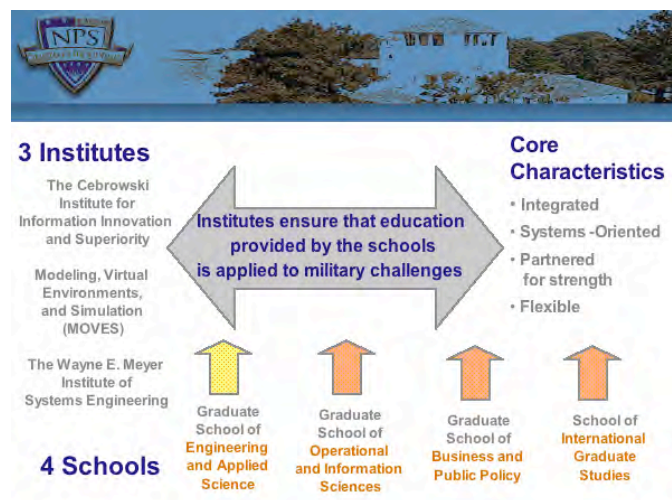
The research program at NPS exists to support the primary mission of graduate education. Research at NPS:

- 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:

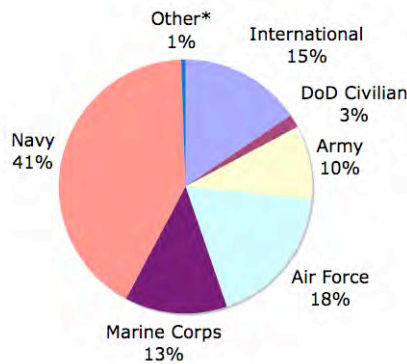
- Europe/Russia/Central Asia
- Far East/Southeast Asia/Pacific
- Middle East/Africa/South Asia
- Western Hemisphere

## **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 December 2006 is shown in Figure 1 on the following page.

# INTRODUCTION

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\*Coast Guard, Army Reserve, Army Reserve National Guard, National Oceanographic and Aeronautics Administration. Total exceeds 100% due to rounding.

**Figure 1: Resident Degrees/Subspecialty Student Population for December 2006  
(Total of 1,799)**

## **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

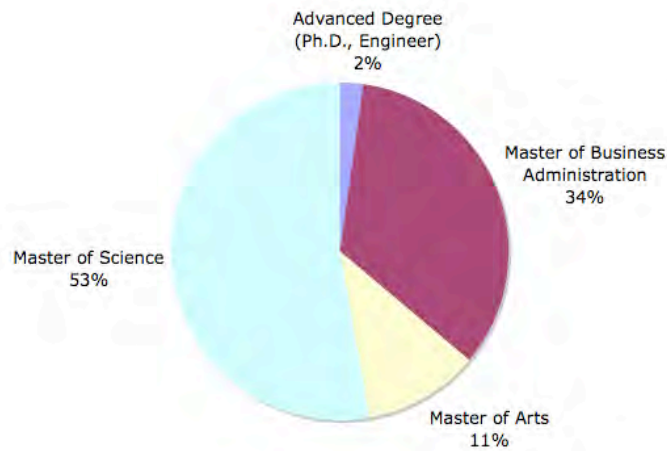


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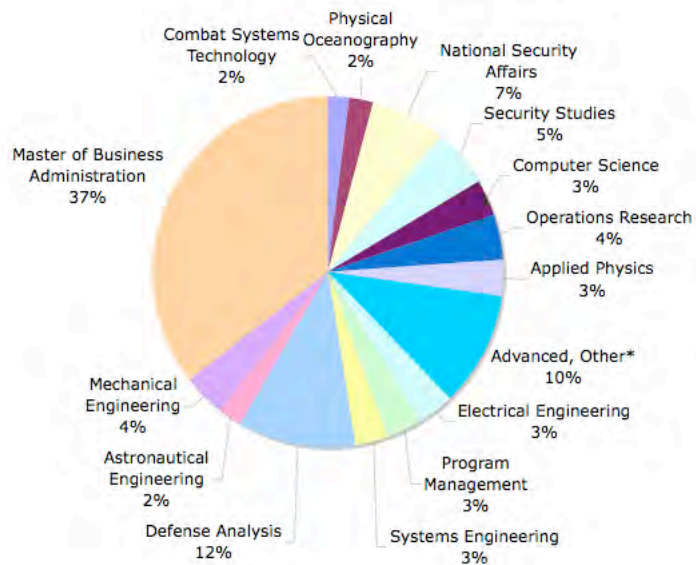
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In December 2006, 318 degrees were conferred. Figure 2 indicates distribution by type, Figure 3 by degree field.



\*Advanced Degrees and Other: Ph.D. Astronautical Engineering (1), Ph.D. Modeling Virtual Environments, and Simulation (1), Ph.D. Applied Mathematics (1), Ph.D. Electrical Engineering (1), Ph.D. Physical Oceanography (1), Astronautical Engineer (1), Mechanical Engineer (1), MS Engineering Acoustics (1), MS Space Systems Operations (1), MS Systems Engineering Management (1)

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



**Figure 3. Degrees Conferred in December 2006  
(318 Degrees Conferred)**

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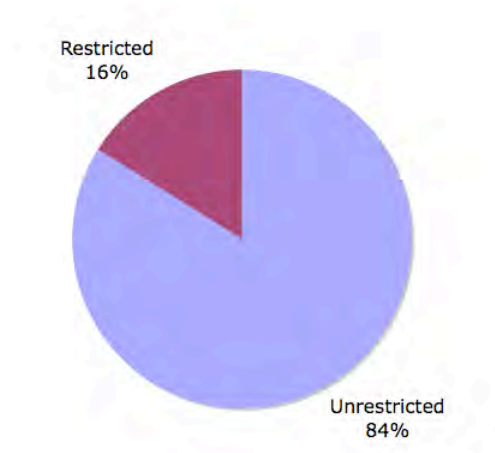
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### **Theses**

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 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  
Astronautical Engineer  
Mechanical Engineer**



# **DOCTOR OF PHILOSOPHY**

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## **HIGH-FIDELITY REAL-TIME TRAJECTORY OPTIMIZATION FOR REUSABLE LAUNCH VEHICLES**

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**B.S., Embry-Riddle Aeronautical University, 1997**

**M.S., University of Dayton, 2000**

**Doctor of Philosophy in Astronautical Engineering-December 2006**

**Advisor: I. Michael Ross, Department of Mechanical and Astronautical Engineering**

Creating simplicity out of complexity, this research abandons the traditional guidance and control architecture for aerospace vehicles and embraces a revolutionary concept based on the principles of nonlinear optimal control theory. Motivated by the emerging needs of the next generation of reusable space vehicles, an autonomous “integrated” guidance and control system is developed that provides a safe approach to the highly constrained and nonlinear reentry problem. A pseudospectral-based optimal guidance scheme is used to generate high-fidelity vehicle-tailored solutions to reentry trajectory optimization and guidance problems. To provide an autonomous, onboard capability of satisfying final-approach requirements, a new method is developed that includes an automatic generation of landing constraints given any runway geometry. This unique and simple approach avoids significant complexities arising from previous ideas of trajectory segmentation, trimmed flight, and trajectory tracking schemes. When demonstrating the new ideas, it is shown that the proposed approach can easily compensate for large uncertainties and disturbances consisting of hurricane-force wind gusts. An investigation of these new principles for the complete, nonlinear six degree-of-freedom system dynamics indicates that while the results are quite promising, a substantial amount of new theoretical and computational problems remain open, particularly in the area of over-actuated dynamical systems.

**KEYWORDS:** Optimal Guidance and Control, Nonlinear Trajectory Optimization, Reentry, X-33, Reusable Launch Vehicles, Path Planning, Replanning, Retargeting, High-Fidelity Modeling, Aerospace Flight Controls, Pseudospectral Methods, DIDO, Real-Time Optimal Control, Pseudospectral Feedback Control, Autonomous Vehicles, Intelligent Systems

## **MODELING MACRO-COGNITIVE INFLUENCE ON INFORMATION SHARING BETWEEN MEMBERS OF A JOINT TEAM**

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**B.S., Cameron University, 1996**

**M.S., Cameron University, 2000**

**Doctor of Philosophy in Modeling, Virtual Environments, and Simulation-December 2006**

**Advisor: Rudolph P. Darken, MOVES Institute (Modeling, Virtual Environments, and Simulation)**

Research exploring the effectiveness of joint military teams lacks the empirical robustness found in similar multicultural team research from the business domain. This research study broadens the study of effective military teams through an assessment of the factors that influence a joint team’s effectiveness by capitalizing on the business and psychological communities’ exploration of successful team performance. Specifically, in three empirical studies, this research examines several key elements of poor team effectiveness identified by the business community, namely cultural differences and personality stereotypes. Study One examines cultural orientation and service personality using a survey instrument. The results show that cultural and personality differences exist at significant levels between the services. The second study examines team information sharing processes in a wargame environment composed of homogeneous and heterogeneous four-person teams. Results reveal that participants in

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## DOCTOR OF PHILOSOPHY

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heterogeneous teams, cued to the presence of cultural and personality differences among team members, perform as well as homogeneous teams. The third study expands the knowledge space of the team experiment by developing an agent-based model replicating the wargame. The model accurately represents the experimental data, confirming the hypothesis that computational models coded with actual datasets from human experimentation are more robust than models coded with notional datasets. The results demonstrate that joint team effectiveness improves by incorporating methodologies used in the business and simulation science communities.

**KEYWORDS:** Cultural Orientation, Personality, Joint Military Team, Agent-Based Modeling, Human Behavior Representation

### **DEVELOPMENT OF A THREE DIMENSIONAL PERFECTLY MATCHED LAYER FOR TRANSIENT ELASTO-DYNAMIC ANALYSES**

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**B.S., Fayetteville State University, 1999**

**M.S., Fayetteville State University, 2000**

**M.S., Naval Postgraduate School, 2005**

**Doctor of Philosophy in Applied Mathematics-December 2006**

**Advisors: Clyde Scandrett, Department of Applied Mathematics**

**Steven R. Baker, Department of Physics**

A three dimensional finite element approach to the development of a perfectly matched layer for numerical calculations of surface wave radiation in a half space is presented. The development of this new element requires the coupling of a system of linear, second-order, partial differential equations that describe elastic wave propagation, together with their related boundary conditions, into a single weak-form (Galerkin) wave equation, from which the characteristics of a composite finite element matching layer are derived. An important problem of interest, and the motivation for this work, is the optimization of a source for use in a seismo-acoustic sonar for the detection of buried mines. Validation of the perfectly matched layer occurs by employing it in a finite element analysis to compute the radiation from a particular transient seismo-acoustic source array and showing that the results agree with the results of previous field experiments using the same source performed by Naval Postgraduate School students. Various source excitations are presented that maximize the energy of the unidirectional Rayleigh wave while suppressing the energy of associated body waves. Radiation characteristics are analyzed in a linear, isotropic, homogeneous half space with a discrete number of transient seismic sources. The hp-adaptive finite element code, SAFE-T (Solid Adaptive Finite Element - Transient), a Finite Element Method (FEM) implementation developed by the author utilizing Altair Engineering's Prophlex kernel, is used to perform the numerical computations. Results for radial and vertical wave strengths are given in terms of their total displacement magnitudes. This work represents an important step forward in the development of tools needed to pursue seismo-acoustic sonar technology for buried mine detection, as well as for the analysis of all three-dimensional, time-dependent elasto-dynamic problems.

**KEYWORDS:** Perfectly Matched Layer, Seismo-Acoustic Sonar, Finite Element, Prophlex Kernel, Rayleigh Energy, SAFE-T, Solid Adaptive Finite Element-Transient, Time-Dependent Elasto-Dynamic Analyses

### **JOINT DEMODULATION OF LOW-ENTROPY NARROWBAND COCHANNEL SIGNALS**

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**M.S., Johns Hopkins University, 2000**

**Doctor of Philosophy in Electrical Engineering-December 2006**

**Advisor: Frank E. Kragh, Department of Electrical and Computer Engineering**

Reception of one or more signals, overlapping in frequency and time with the desired signal, is commonly called cochannel interference. Joint detection is the optimal minimum probability of error decision rule for cochannel interference. This dissertation investigates the optimum approach and a number of suboptimum

approaches to joint detection when a priori information based in fields, or sets of transmitted symbols, is available. In the general case, the solution presents itself as a time-varying estimation problem that may be efficiently solved with a modified Bahl, Cocke, Jelinek, and Raviv (BCJR) algorithm.

The low-entropy properties of a particular signal of interest, the Automatic Identification System (AIS), are presented. Prediction methods are developed for this signal to be used as a priori information for a joint field-based maximum a posteriori (MAP) detector. Advanced joint detection techniques to mitigate cochannel interference are found to have superior bit error rate (BER) performance than can be obtained compared to traditional methods.

**KEYWORDS:** Multiuser Detection, Signal Processing, Communications, Low-Entropy, Classification, Joint Detection

### **MODELING STUDIES OF THE COASTAL/LITTORAL CURRENT SYSTEM OFF SOUTHERN AUSTRALIA**

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**M.S., Naval Postgraduate School, 2001**

**Doctor of Philosophy in Physical Oceanography-December 2006**

**Advisor: Mary L. Batteen, Department of Oceanography**

Both theoretical and numerical modeling studies of the current system off western and southern Australia are conducted to characterize the features of the current system, their temporal variability, and their impact on the sound speed structure. The theoretical study examines why boundary current separation occurs off Cape Leeuwin, creating an area of enhanced eddy generation. It is shown that the beta effect, vortex stretching, and streamline curvature all act to decelerate the current and to thus enhance separation. The current is then turned left under the influence of Coriolis force and subsequently forms meanders, which then detach from the current as eddies.

The model results, using the Princeton Ocean Model (POM), reproduce the main features of the current system. They also provide insight into the generation of the main features. In particular, the current direction is caused by the thermohaline gradient, while topography is responsible for the location of the current along the shelf break. Current speed results from a combination of thermohaline gradient, the opposing wind, and topography, while meanders and eddies result from the opposition of the thermohaline and wind forcing. The gyre and upwelling in the Great Australian Bight are caused by the change in wind direction in summer.

Daily wind experiments are shown to capture the seasonal variability of the current system, with the Leeuwin Current along the western coast stronger in winter than in summer and mesoscale activity highest in summer. Seasonal and interannual variability are highlighted with the gyre and upwelling in the bight and along Kangaroo Island appearing intermittently but always in summer. Lastly mesoscale features in the current system, advection of water by the surface current and undercurrent, eddies, and upwelling are all shown to cause significant changes in sound speed, which can adversely affect sonar operations.

**KEYWORDS:** Leeuwin Current System, Ocean Modeling, Princeton Ocean Model, POM, Eddy, Mesoscale, Great Australian Bight, Australia, Boundary Current Separation



# ASTRONAUTICAL ENGINEER

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## **RAPID MOTION PLANNING AND AUTONOMOUS OBSTACLE AVOIDANCE FOR UNMANNED VEHICLES**

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B.S., Virginia Tech, 2001**

**Astronautical Engineer-December 2006**

**Master of Science in Astronautical Engineering-December 2006**

**Advisor: I. Michael Ross, Department of Mechanical and Astronautical Engineering**

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This work introduces the use of optimal control methods for path planning and control of autonomous vehicles in an obstacle-rich environment. Traditional techniques harbor non-optimal, closed architectures primarily derived at a time when computational complexity could significantly hinder overall system performance. Advancements in computing power, miniaturization, and numerical methods permit the utilization of online, optimal path planning and control, thereby improving system flexibility and autonomy. The backbone of this concept is state-of-the-art optimal control techniques involving pseudospectral methods and sequential quadratic programming. Although this research focuses on a robotic car or Unmanned Ground Vehicle (UGV), several systems, including an Unmanned Aerial Vehicle (UAV) and a pendulum on a rotational base, are detailed for the purpose of illustrating the technique's modularity. With respect to the UGV, optimal control methods permit the optimization of maneuver parameters while accounting for complex vehicle kinematics and workspace obstacles, represented as dynamic and path constraints respectively. The path constraints are modeled such that an obstacle of any shape or size can be included. Maneuvering trajectories are first generated in an open-loop architecture, followed by an application of these same techniques in feedback form. Lastly, model fidelity is increased to improve control over vehicle behavior and closed-loop performance and a local knowledge scenario is evaluated.

**KEYWORDS:** Optimal Control, Trajectory Optimization, Path Planning, Autonomous Ground Vehicles, Real-Time Optimal Control, DIDO, Pseudospectral Methods Application





# MECHANICAL ENGINEER

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## **DESIGN, MODELING, AND PERFORMANCE OF A SPLIT-PATH, JP-10/AIR-PULSE DETONATION ENGINE (PDE)**

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

**Mechanical Engineer-December 2006**

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

The initiation of a detonation in Pulse Detonation Engines (PDE) has been identified as one of the critical and enabling technologies for PDEs. In particular, the initiation of practical fuel-air mixtures containing liquid droplets without supplementary oxygen or other high loss mechanisms is a capability that could enable the PDE to exceed the performance of ramjets and expendable turbo-machinery based systems. Although past engine designs have relied upon a sensitive fuel/oxygen initiator unit or unrealistic gaseous fuels, such as ethylene and propane, a PDE is designed and partially tested that eliminates the requirement for supplementary oxygen and enables the use of a JP-10, high-density liquid fuel. Air flow through segments of this PDE is simulated using Computational Fluid Dynamics and experimentally evaluated in the laboratory at simulated flight conditions, including supersonic cruising conditions. The spiral lined initiator demonstrates a lower total pressure loss when compared to the geometry with rings, and thus is the preferred initiator configuration. Experimental values for the turbulence are found to be significantly lower than the computed values at similar conditions when using the  $k-\epsilon$  model. Finally, successful ignitions of the JP-10/Air initiator at frequencies of up to 20 Hz are experimentally demonstrated.

**KEYWORDS:** Pulse Detonation Engines, PDE, PDE Ignition, Transient Plasma Ignition, TPI, Refresh Mach Number, Split Path, JP-10



**MASTER  
OF  
BUSINESS ADMINISTRATION**



# **MASTER OF BUSINESS ADMINISTRATION**

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## **COST-BENEFIT ANALYSIS OF PERFORMING A PILOT PROJECT FOR HYDROGEN-POWERED, GROUND-SUPPORT EQUIPMENT AT LEMOORE NAVAL AIR STATION**

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**Kenneth H. Doerr, Graduate School of Business and Public Policy**

The primary purpose of this thesis is to provide a cost benefit analysis of a pilot program at Naval Air Station (NAS) Lemoore for the use of hydrogen fuel cell powered aviation ground support equipment (GSE) and to provide general background information on hydrogen power. An analysis is conducted to determine expected program costs and to identify what benefits the Navy could achieve by using hydrogen fuel cell powered tow tractors, electric carts, and hydraulic carts. The analysis shows benefits in the following areas: reduced green house gas emissions and noise pollution, reduced hazardous materials (HAZMAT) generation due to reduced oil usage and spills/leaks, reduced maintenance labor costs for fuel cell over diesel engines, and reduced training time required after full fleet fuel cell implementation.

**KEYWORDS:** Hydrogen Power, Aviation Ground Support Equipment, GSE, Cost Benefit Analysis Model

## **A COST BENEFIT ANALYSIS OF RADIO FREQUENCY IDENTIFICATION (RFID) IMPLEMENTATION AT THE NAVAL POSTGRADUATE SCHOOL'S DUDLEY KNOX LIBRARY**

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**Ira Lewis, Graduate School of Business and Public Policy**

The purpose of this MBA project is to evaluate the potential of implementing radio-frequency identification (RFID) technology at the Naval Postgraduate School's Dudley Knox Library (DKL). DKL is an academic library supporting a graduate student population only. This study includes both quantitative and qualitative analyses. A cost-benefit analysis (CBA) is conducted using data gathered from research, including personal interviews, site visits, and a survey questionnaire. Time and motion studies of selected library processes are conducted at DKL and a major public library. Vendors were invited to submit proposals for RFID systems to get the latest equipment available, with associated cost estimates. The qualitative analysis addresses the advantages and disadvantages of an RFID system, as well as privacy and other ancillary issues surrounding its implementation. This study does not attempt to quantify potential savings from collection management, an intangible benefit that could be addressed in future studies. Finally, the study presents several options to aid NPS decision makers on whether or not to implement an RFID system at DKL.

**KEYWORDS:** RFID, Radio Frequency Identification, Libraries, Cost Benefit Analysis

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# MASTER OF BUSINESS ADMINISTRATION

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## **SYSTEM SUPPORT/SUSTAINMENT PLAN PLATFORM FOR THE DEFENSE ENTERPRISE ACCOUNTING MANAGEMENT SYSTEM (DEAMS)**

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**Master of Business Administration-December 2006**

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**Ronald B. Tudor, Graduate School of Business and Public Policy**

Secretary of Defense Donald Rumsfeld, in a memo dated 19 July 2001, indicated that one of his highest priorities in transforming the Department of Defense (DoD) was to have reliable, accurate, and timely financial management information. To facilitate this, Secretary Rumsfeld established the Business Management Modernization Program (BMMP). The BMMP is an implementation program charged with transforming the DoD's framework. One of the initiatives of the BMMP is to provide a modern financial management system that transforms business operations to achieve improved warfighter support while enabling financial accountability. The tool, the Defense Enterprise Accounting Management System (DEAMS), is a modified commercial, off-the-shelf, financial-management system. DEAMS is expected to transform DoD financial management so that timely and accurate information supports effective decision-making. According to DoD guidance, to effectively develop, acquire, test, and support DEAMS, it is critical that system resources are identified, tracked, and evaluated. Throughout this document, this process is referred to as a support/sustainment plan. To date, a viable system support/sustainment plan has not been developed for DEAMS. The focus of this MBA project is to create a platform for a support/sustainment plan. The support plan is a living management tool. Its purpose is to ensure that the system performs to warfighters' requirements and identifies system performance shortcomings over its life cycle

**KEYWORDS:** Information Support Plan, ISP, Defense Enterprise Accounting Management System, DEAMS

## **DISCRETE-EVENT SIMULATION MODELING OF THE REPAIRABLE INVENTORY PROCESS TO ENHANCE THE AGILE RAPID GLOBAL COMBAT SUPPORT (ARGCS) BUSINESS-CASE ANALYSIS**

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The objective of this project is to identify and more accurately predict the maintenance and supply chain costs and savings related to the Agile Rapid Global Combat Support (ARGCS) system. The project focuses on a portion of the ARGCS business-case analysis (BCA) model developed by CDR David Crosby. CDR Crosby's BCA model lists various potential savings associated with ARGCS technologies that were difficult to quantify during his initial BCA research. The focus of this research is to determine the likely benefits and/or cost savings that ARGCS may have on maintenance and supply functions. Using pre-existing maintenance and supply data, a simulation model is developed to more accurately determine any maintenance and/or supply related cost benefits. The goal is to provide better accuracy on the associated costs and benefits of ARGCS technologies, thus enhancing the accuracy and merit of future BCAs. The only F/A-18 weapons-replaceable assemblies (WRA) analyzed during this research project are those that will be tested during the summer 2007 advanced-concept-technology demonstration (ACTD) at Lemoore Naval Air Station. Results of the simulation indicate that there is an expected increase in operational availability and several cost savings associated with the implementation of ARGCS technologies.

**KEYWORDS:** Advanced Concept Technology Demonstration, Agile Rapid Global Combat Support, Discrete-Event Simulation Modeling, Repairable Inventory Process, ARGCS Business Case Analysis

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# **MASTER OF BUSINESS ADMINISTRATION**

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## **INCREASING THE OPERATIONAL AVAILABILITY OF H-60 CALIBRATION SUPPORT EQUIPMENT**

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**Master of Business Administration-December 2006**

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

The purpose of this MBA project is to identify inefficiencies in the H-60 support equipment calibration process at Naval Air Station, North Island, and to analyze their impact on operational availability. To conduct this analysis, researchers map the standard calibration process at North Island from beginning to end from a using unit perspective. After identifying the process, researchers calculate the inherent and operational availability and determine the impacts of process inefficiencies on asset operational availability. The researchers propose changes to reduce the effects of process inefficiencies on using unit asset availability and provide guidance for further study.

**KEYWORDS:** Calibration, Support Equipment, Operational Availability, Process Inefficiencies

## **LINKING PLANNING, PROGRAMMING, BUDGETING, AND EXECUTION SYSTEM (PPBES) AND THE PROGRAMMED OBJECTIVE MEMORANDUM (POM) WITH CAPABILITIES**

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Recent Chairman of the Joint Chiefs of Staff Instructions (CJCSI) direct the development of new concepts to prioritize linking budgeting and programming for near- and mid-term resource allocation planning. For the Department of Defense (DoD), planning that falls within the Future Years Defense Plan (FYDP) or 0-7 years may be viewed as midterm. This thesis raises the question of whether these new concepts will work best for the Department of the Navy (DoN) or whether another methodology would better fit the Navy's near- and mid-term needs. Further, the thesis asks whether the implementation of the recently promulgated CJCSI instructions would be more disruptive to the DoN instead of an alternative modification of what the DoN is already using successfully.

This thesis also explores the potential value of the newly formed capability-planning initiative within the DoN. The Navy initiative is compared to private-sector practices to define similarities and to develop additional potentially useful methods. The thesis also explores the potential usefulness of linear programming or mathematical decision modeling for the application of weights and values to relate input variables and relationships to desired outputs. Finally, procurement narrative statements in the fiscal year 2007 DoN budget are analyzed and results, in terms of use of the capability concept, are reported.

**KEYWORDS:** Programmed Objective Memorandum, Defense Capabilities, Planning Programming Budgeting and Execution System, Capability Development Process



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# MASTER OF BUSINESS ADMINISTRATION

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## MODELING THE ADOPTION PROCESS OF THE FLIGHT TRAINING SYNTHETIC ENVIRONMENT TECHNOLOGY (FTSET) IN THE TURKISH ARMY AVIATION (TUAA)

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The motivation for using Flight Training Synthetic Environment Technology (FTSET) in military aviation is to create a cost-efficient and risk-managed training environment. However, deciding on the appropriate mix of synthetic versus actual flight training remains a great, unresolved issue. Further, FTSET usage and its adoption level may vary across the aviation community and flight training curricula.

Turkish Army Aviation (TUAA) has employed FTSET in helicopter flight training since 1990. Since then, it has exhibited three different FTSET Support Usage patterns, including an initial phase of lower support rates until 1997, a substantial increase phase from 1997-2001, and a leveling-off phase (where growth stagnated) from 2001-2006. It is hypothesized that this sequential phasing can be explained in terms of the organizational culture in which the FTSET is employed, organizational changes that favor FTSET usage and increasing FTSET expertise in the usage, and the current FTSET's limited technical capability and its sole support for one type of helicopter.

To test the hypotheses, a systems dynamics model of the FTSET adoption process (AP) that has three interrelated sectors, is developed: technology improvement and acquisition, technology adoption, and technology discarding. The diffusion model is also used as a framework to help explain the TUAA's FTSET AP from 1990 to 2006. The purpose is to understand this AP and to generate a policy for the current and future FTSET AP.

**KEYWORDS:** Flight Training Synthetic Environment Technology, FTSET, Flight Training Curriculum, Flight Simulators, FS, Synthetic Training Devices, STD, Systems Dynamics, SD, Adoption Process, AP, The Diffusion Model, Diffusion of Innovations Theory, Source-, User-Centered Adoption Models, Technology Awareness, Transfer of Training, Perceived Ease of Use, PEU, Perceived Usefulness, PU

## TOTAL OWNERSHIP COST REDUCTION CASE STUDY: AEGIS RADAR PHASE SHIFTERS

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Master of Business Administration-December 2006

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James B. Greene, RADM, USN (Ret.), Acquisition Chair Professor

The purpose of this MBA project is to provide a case study that captures the production and design processes and program management solutions used to reduce total ownership costs of AEGIS Radar Phase Shifters. Specifically, it focuses on the design and redesign of the SPY-1 radar phase shifter; a redesign that dramatically improved performance without increasing average procurement unit costs (APUC). Researchers analyze various process-improvement projects (PIP) used to reduce touch-labor and improve production process yield (percentage of manufactured items that are defect-free) of SPY-1B/D phase shifters. Researchers also review programs that improved phase shifter production either directly or indirectly, i.e., consolidated purchasing, lean and six sigma, productivity improvement projects, etc. This case study is conducted with the sponsorship and assistance of the Acquisition Research Program, Graduate School of Business and Public Policy, Naval Postgraduate School, Monterey, California.

**KEYWORDS:** AEGIS, SPY-1, Radar, Phase Shifter, Total Ownership Costs, Production Costs

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## **MASTER OF BUSINESS ADMINISTRATION**

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### **IMPLEMENTING THE NATIONAL INVENTORY MANAGEMENT STRATEGY: A CASE STUDY ON THE DEFENSE LOGISTICS AGENCY'S NATIONAL INVENTORY MANAGEMENT STRATEGY (NIMS)**

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**Master of Business Administration-December 2006**

**Francis S. Diaz-Captain, United States Marine Corps**

**Master of Business Administration-December 2006**

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**Master of Business Administration-December 2006**

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Since 1990, the Government Accountability Office (GAO) audits have assessed supply chain management as a high-risk area within the Department of Defense (DoD). In response to these findings, the Defense Logistics Agency (DLA) developed the National Inventory Management Strategy (NIMS) initiative. This initiative combines the consumable repair inventories of DLA (wholesale level) and each armed service (retail level) into a single national inventory. The United States Navy and DLA established test sites at Naval Air Station Ingleside, Naval Air Station Whidbey Island, and Marine Corps Air Station Miramar to demonstrate its benefits and measure its performance. The aim of this report is to analyze NIMS' preliminary performance metrics in terms of effectiveness and its impact on supply chain management within the Navy and DLA.

**KEYWORDS:** Supply Chain Management, Inventory Management, Consumable Repair Inventory, Single National Inventory, National Inventory Management Strategy

### **A CRITICAL ANALYSIS OF THE COORDINATION, COMMAND, AND CONTROL OF CONTRACTORS IN IRAQ**

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**Master of Business Administration-December 2006**

**Matthew F. Howes-Major, United States Marine Corps**

**Master of Business Administration-December 2006**

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**Ronald B. Tudor, Graduate School of Business and Public Policy**

The purpose of this project is to examine the issues concerning the command and control of civilian contractors in a combat environment. Outsourcing non-military specific job functions to civilian contractors and the increased reliance on private security companies to protect those contractors has produced unexpected complications when examined in the context of an extended wartime scenario. The objectives of this project are to identify the weaknesses of current command and control doctrine as it applies to civilian contractors, to identify significant issues regarding tracking and movement control of contractors, and to identify issues faced by tactical commanders created by civilian contractors operating in their battlespace. The product of this project is a potential course of action that the Department of Defense can pursue to correct deficiencies in the command and control of contractors and to mitigate the risks created by contractors operating independently on the battlefield.

**KEYWORDS:** Contingency, Contracting, Contingency Contracting, Private Security Company, Private Military Firm, Reconstruction Operations Center, Command, Control, Movement Control

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## **MASTER OF BUSINESS ADMINISTRATION**

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### **DEPOT-LEVEL-REPAIRABLE CARCASS TRACKING AND THE ELECTRONIC, RETROGRADE, MANAGEMENT SYSTEM**

**Troy D. Carr-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

**Brett K. Wilcox-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

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**Bryan J. Hudgens, Lt.Col., USAF, Graduate School of Business and Public Policy**

The purpose of this project is to develop a Department of the Navy-related case study for use in future supply-chain-management courses at the Naval Postgraduate School, Monterey, California. Pursuant to this objective, the depot-level-repairable program of the U.S. Navy is studied. The case progresses through a background of the DLR program, the Advanced Traceability and Control (ATAC) system currently in fleet-wide use, and the improved process being implemented, the Electronic Retrograde Management System (e-RMS). Through a study of the component processes partnered with selected data for analysis, the case highlights several fundamental concepts of supply chain management and provides for both qualitative and quantitative discussion.

**KEYWORDS:** DLR, Depot Level Repairable, Carcass Tracking, ATAC, Advanced Traceability and Control, Electronic Retrograde Management System

### **COMMANDER, NAVAL AIR FORCES, AIRCRAFT-OPERATIONS MAINTENANCE: AN EXAMINATION OF EFFECTIVENESS IN MAINTAINING AND OPERATING AN AGING AIRCRAFT FLEET**

**Kenny K. Chase-Captain, United States Marine Corps**

**Master of Business Administration-December 2006**

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**Master of Business Administration-December 2006**

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

There are two primary objectives of this research. First, the report summarizes the funding elements of intermediate-maintenance activity (IMA)/organizational maintenance activity (OMA). Identifying the funding formulation and current cost trends of maintaining an aging fleet of aircraft emphasizes the need for strategic positioning with effective programs and financial plans to meet the Chief of Naval Operations' readiness goals. Second, the research provides an analysis of current and future maintenance programs designed to build efficiency and save money. Specifically, the study examines the Radar Center of Excellence Naval Air Station Lemoore as it relates to cost-wise readiness and Enterprise AIRSpeed. These programs highlight changes following the Navy's attempt to transform to a more efficient and lean aircraft maintenance process model. The study aims to provide insight into whether these changes have resulted in improved program efficiency and achieved cost savings in aircraft-operations maintenance expense accounts.

**KEYWORDS:** Aircraft Operations Maintenance, Naval Aviation, Fleet Readiness Center, FRC, Enterprise AIRSpeed

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### **ANALYZING THE STRUCTURE OF AIR FORCE SPACE ACQUISITION**

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

In this joint applied project, the current structure of the acquisition arm of Air Force Space Command is analyzed using the policies and process cornerstone of the “Framework for Assessing the Acquisition Function at Federal Agencies.” The acquisition arm belonged to Air Force Materiel Command until 1 October 2001, when the reins were transferred to Air Force Space Command to provide “cradle-to-grave” management from concept through development, acquisition, sustainment, and final disposal of space systems. The objective of this research is to determine whether the current Air Force Space Acquisition policies and processes are efficient and effective according to the GAO-05-218G “Framework for Assessing the Acquisition Function at Federal Agencies.” This research provides results of a survey conducted by Space and Missile Center personnel. Recommendations for improvements are included.

**KEYWORDS:** Space Acquisition, Assessment

### **THE MILITARY HEALTHCARE SYSTEM (MHS) PHARMACY BENEFIT: EFFICACY OF CIVILIAN COST-SAVING STRATEGIES**

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A contributing factor in the rising costs of the Military Healthcare System (MHS) budget is the pharmacy benefit. In efforts to reduce or contain the costs associated with this benefit, the MHS has implemented several cost saving strategies that were adopted directly from private health care organizations. These strategies include formulary restrictions, generic substitutions, and beneficiary cost sharing that uses a tiered co-payment structure. These strategies are primarily designed to save costs by influencing the behaviors and attitudes of beneficiaries, restricting their access to options with higher costs, and directly shifting a portion of the programs cost through co-payments. This thesis concludes that by implementing these utilization management strategies, the MHS has experienced results that are as good as or better than those experienced by the civilian sector. However, Tricare pharmacy expenditures continue to increase at a faster rate than other components of the MHS, demonstrating that the implementation of these strategies, though successful when compared to civilian benchmarks, have not sufficiently contained Tricare pharmacy expenditures. To be successful, the Department of Defense must use a multifaceted approach to contain these escalating expenditures. Ultimately, dramatic cost shifting may be the only way to lower expenditures.

**KEYWORDS:** Healthcare, Pharmacy, Utilization Management, Military Health System

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## **BUSINESS-CASE ANALYSIS OF COMPREHENSIVE MARITIME AWARENESS**

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This research project develops a business case analysis model to evaluate the costs and benefits of utilizing the Comprehensive Maritime Awareness (CMA) system within the Department of Defense (DoD). The business case analysis model is developed to conduct a detailed evaluation of the economic costs and benefits associated with CMA. The initial hypothesis favors CMA as a superior alternative to the existing system, Maritime Domain Awareness (MDA). Throughout the course of the research, this opinion is solidified and supported based on a series of factors. These factors are expressed and outlined in the observations, conclusions, and recommendations.

**KEYWORDS:** Comprehensive Maritime Awareness, CMA, Maritime Domain Awareness, MDA, Business Case Analysis, BCA

## **THE DEVELOPMENT OF A LOGISTICAL BODY OF KNOWLEDGE FOR THE DEPARTMENT OF DEFENSE**

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The purpose of this MBA project is to identify and provide a basic but comprehensive overview of current logistical and supply chain management practices relevant to the Department of Defense (DoD). This project is conducted with the assistance of Naval Postgraduate School professors versed in transportation, logistical, and financial management disciplines. Presented in an annotated bibliography format, the project identifies concepts, theories, articles, journals, and perspectives that will be useful to all DoD users. The objective is to examine the logistics culture from these perspectives and to provide a tool allowing a standardized level of knowledge, subsequently generating a dynamic pool of knowledge encompassing logistical theories and qualitative decision-making tools.

**KEYWORDS:** Logistics Operations, Asset Visibility, Supply Chain Management

## **ECONOMIC LIMITS TO CORPORATE GROWTH IN AMERICA**

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This work explores the relationship between corporate and economic growth within the United States since 1929. The corporate share of gross domestic product (GDP) climbed from 52.5 percent in 1929 to 59.7 percent in 2005. Depending upon the years included and the method of estimating respective growth rates, this increasing share of GDP accounts for up to 14 percent of real domestic corporate growth. However, the domestic corporate share of GDP can never exceed 100 percent. Subject to numerous assumptions, the models presented here estimate that this source of corporate growth could be exhausted as early as the year

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2032. Given the lack of discussion of this issue in the relevant literature, it is unlikely that current stock valuations account for the eventual loss of this source of growth. The actual effect on stock prices of such a slowdown of domestic corporate growth will depend not only on how far into the future such an event occurs, but also on how successful these corporations are at finding new growth opportunities overseas. More research is needed to better model future growth patterns and to understand the implications on stock valuations and other related policy matters.

**KEYWORDS:** TERMS Corporate Value Added, Corporate Growth, Stock Valuation, Value-Added Accounting

### **A STRATEGIC DECISION MATRIX FOR ANALYZING FOOD SERVICE OPERATIONS AT AIR FORCE BASES**

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For years, services organizations have operated dining facilities with little change to strategic direction for the type of operation they should implement. Contracts, regardless of type, often run on auto pilot. Organizations renew the contracts when their option years run out with little change or modification to the contract. The only thing that seems to change is the ever increasing price of the contract and perhaps the contractor. This analysis attempts to provide a framework for change that provides a tool for decision makers to utilize when faced with a feeding contract that has reached the end of its service life. Through this analysis, a “decision matrix to select a food service system for Air Force bases (AFB)” is developed. The decision matrix helps answer the question of which food service operation should be implemented at any AFB. The matrix includes criteria to evaluate the options while guiding the type of contract or in-house service that best meets the base requirement. In addition, to be of use to any services organization at any AFB, the decision tool is adaptable to the specific requirements and constraints of any evaluator.

**KEYWORDS:** Services, Strategic Decision Matrix, Food Service, Mess Attendant, Dining Facility, Feeding Contract, Non-Appropriated Fund Memorandum of Agreement

### **FEASIBILITY STUDY OF THE DEPARTMENT OF THE AIR FORCE INFORMATION TECHNOLOGY COMMODITIES COUNCIL (ITCC) DIGITAL PRINTING AND IMAGERY (DPI) INITIATIVE**

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The purpose of this project is to further provide conceptual direction for implementing the Air Force Digital Printing and Imagery (DPI) initiative through the Information Technology Commodities Council (ITCC). The project begins with the background and reasoning why Air Force organizations should implement DPI. Objectives are to develop a consistent plan and model for bases and organizations to do quick assessments of their DPI requirements based on a set standard of guidelines. Proposed policy guidance for implementing DPI in accordance with the Air Force Electronic Records Management policy accompanies this plan. This project also provides recommendations for marketing the plan throughout the Air Force to promote a smooth transition and implementation. The product consists of the overall recommended guidance for the ITCC to implement this initiative, including a model for quick assessments,

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requirements determination, and post implementation guidance. Finally, the project discusses the future of this initiative and provides recommendations for further research and development.

**KEYWORDS:** Information Technology, Printers, Print Services, Copiers, Electronic Records Management, Paperwork Reduction, Multi-Function Devices, Scanners, Fax Machines

### **AN ANALYSIS OF EARNED VALUE MANAGEMENT IMPLEMENTATION WITHIN THE F-22 SYSTEM PROGRAM OFFICE'S SOFTWARE DEVELOPMENT**

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Department of Defense (DoD) use of the Earned Value Management (EVM) program control tool has significantly increased in the last ten years. DoD acquisition policy and training promotes EVM as a cost and schedule management tool, tracking the earned value of the work completed per the baseline plan. Acquisition Category ID programs, such as the U.S. Air Force F-22 fighter program, use EVM to manage their software development efforts, but has the program's implementation of EVM followed the industry-recognized 32 criteria outlined in ANSI/EIA-748-A-1998 (Earned Value Management System Standards) necessary to successfully implement EVM?

Using these 32 criteria, an evaluation is performed, aimed at assessing the implementation of EVM in the F-22 program. The goal is to academically appraise the program's use of EVM in managing Spiral 2, an F-22 avionics software modernization effort. To accomplish this goal, a detailed evaluation of how the program meets the 32 criteria is conducted, along with analysis of program data, interviews of subject matter experts, and a statistical questionnaire conducted with F-22 personnel. Results indicate areas of possible improvement in the use of EVM and potential changes to the F-22 development environment to improve planning, scheduling, and budgeting of the EVM baseline.

**KEYWORDS:** Earned Value Management System, EVMS, F-22, Software Acquisition Management

### **INDUSTRY ANALYSIS FOR BODY ARMOR PROCUREMENT**

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In order to leverage buying power, reduce costs, and improve supplier management, the United States Air Force (USAF) needs to take a strategic approach to acquiring goods and services. Both academic and business literature promote strategic sourcing as a viable method to minimize costs and guard against materials disruptions. In addition, the Office of Management and Budget has required that each agency create strategic sourcing initiatives, monitor the cost savings, and report the results to the Office of Federal Procurement Policy. However, utilization of strategic sourcing techniques and processes within the USAF is relatively new and its full benefit has not been realized. Continued efforts by the USAF to integrate strategic sourcing into its acquisition processes will yield further cost savings and other related supply chain improvements. To assist with improving the strategic sourcing efforts of the USAF, this research seeks to identify viable methodologies for conducting industry analysis. This is important and relevant because conducting an industry analysis is a critical step toward developing an effective sourcing strategy.

**KEYWORDS:** Industry Analysis, Body Armor, Contracting, Commodity Council, Strategic Purchasing, Strategic Sourcing, Procurement, Supply Chain Management

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## **A COMPARATIVE HISTORY OF DEPARTMENT OF DEFENSE MANAGEMENT REFORM FROM 1947 TO 2005**

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The purpose of this MBA project is to document and analyze the history of management reform within the Department of Defense (DoD) from 1947 through the present day, based on the annual reports of the Secretaries of Defense to the Congress. Since its inception in 1947, the DoD has undergone nearly constant management reforms. It appears that each administration attempts to introduce some type of management reform agenda to improve the DoD business processes and incorporate recent management ideas from the business community. Some of the changes are real and significant; others are changes in name only. Through analysis of annual reports of the Secretaries of Defense, a compilation of significant management reforms is created for each Secretary. These reforms are analyzed and compared to one another to identify both general trends and truly unique changes in management practices. Ultimately, this analysis will help distinguish the relative significance in the management reform effort of both the individual Secretaries and the specific reform initiatives.

**KEYWORDS:** Management Reform, Defense Management, Management Trends, Secretary of Defense, Department of Defense

## **IMPLEMENTING COORDINATIVE ACQUISITION AS A VIABLE STREAMLINED ACQUISITION PROCESS IN THE DEPARTMENT OF DEFENSE (DOD): WILL CONTRACTORS PARTICIPATE?**

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The purpose of this MBA project is to discuss the use of the Coordinative Acquisition Tool, which supports Defense Acquisition Performance Assessment (DAPA) recommendations calling for more streamlined acquisition architecture. Specifically, an analysis is conducted of the coordinative acquisition strategy as presented by Dr. Joseph P. Avery in his January 2006 presentation entitled, "Coordinative Acquisition Strategies; Hyperswift Response to the Warfighter," as an acquisition tool used outside of the Federal Acquisition Regulation (FAR). This method is compared to Department of Defense (DoD) Directive 5000.1, DAPA, and other acquisition policies calling for acquisition cycle-time reduction and for a more simplified acquisition architecture. A case study is also conducted on the Rapid Identification Friend or Foe (RIFF) test kit prototype. Lessons learned as they relate to DoD-wide implementation of coordinative acquisition as a viable streamlined acquisition tool for rapid acquisition of immature technologies necessary for warfighter support are developed. Interviews with government and industry representatives at all levels are discussed in order to better explore legal and ethical considerations of coordinative acquisition. Feedback from these interviews provides useful insight into industry's actual willingness to accept this form of acquisition for future projects within the DoD.

**KEYWORDS:** Coordinative Acquisition, Acquisition Reform, Acquisition Architecture, Streamlined Acquisition, Gunshot-Residue Testing, GSR Testing, Rapid Identification Friend or Foe Test Kit, RIFF Test Kit, Defense Acquisition Performance Assessment



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### **EMPLOYING ORGANIZATIONAL MODELING AND SIMULATION TO REDUCE F/A-18E/F F414 ENGINE MAINTENANCE TIME**

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The goal of this project is to determine how to decrease the F414 engine throughput time at the Aircraft Intermediate Maintenance Division (AIMD) at Naval Air Station (NAS) Lemoore, California. To achieve this goal, organizational modeling is employed to evaluate how changes to the organizational structure of the Lemoore AIMD affect engine throughput time. Data collected to build the organizational model is acquired via interviews with AIMD personnel. A baseline model of the AIMD organization is developed for the purpose of modeling the organization's current structure and performance. The actual, real-world duration required to conduct F414 maintenance is compared to the duration predicted by the model and determined to be within 3%. Once confidence is gained that the baseline model accurately depicts the organization's actual F414 maintenance performance, modifications or interventions to the model are made to evaluate how organizational changes would affect F414 maintenance duration. Interventions include paralleling the tasks associated with accomplishing administrative paperwork when initially receiving the F414 engine, and tasks associated with on-engine maintenance, combining personnel positions, adding personnel, and modifying the duration and frequency of meetings. The modeled results of these modifications indicate that the paralleling effort significantly decreases the F414 maintenance duration; likewise, decreasing meeting frequency and slightly increasing duration also facilitates a decreased duration.

**KEYWORDS:** AIRSpeed, Organizational Modeling, Simulation, Cycle-Time, Virtual Design Team, VDT, Aviation Intermediate Maintenance Activity, AIMD, F414 Engine

### **CRITICAL SUCCESS FACTORS AND THEIR APPLICATION TO DEPARTMENT OF DEFENSE (DOD) WEAPON SYSTEM ACQUISITION**

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Department of Defense (DoD) weapon systems are growing more complex and expensive and the services are under increasing pressure from Congress to improve the cost schedule and performance of their weapons programs. The purpose of this project is to investigate and provide an overview of issues within the DoD acquisition system and to provide information to assist program managers in dealing with some of the challenges they face. The goal of this project is to identify Critical Success Factors and determine if they could be applied to DoD acquisition programs in order to improve the acquisition process and provide program managers with a tool to assist them with managing a complex program.

**KEYWORDS:** Critical Success Factors, Program Management, DoD Acquisition Programs, Weapon System Development

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### **CONTRACTORS AND THE COST OF WAR: RESEARCH INTO ECONOMIC AND COST-EFFECTIVENESS ARGUMENTS**

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Since the end of the Cold War, the Department of Defense (DoD) has led unprecedented efforts in outsourcing and privatization. Empirically, private firms offer efficiency incentives and cost savings that are maximized in competitive markets. Recent contingency operations have underscored the importance of contractors, as evidenced by the number and magnitude of reconstruction contracts. In turn, utilizing private contractors has raised questions regarding their true cost-effectiveness. This research highlights the key features of the private military industry from an economic perspective. After revisiting DoD's initial objectives for outsourcing many of their traditionally in-house roles, an assessment is made to whether current efforts are based primarily on capability or financially-driven constraints. The economics of privatization are subsequently explored, with particular emphasis on current contracting efforts. The research provides deeper insight into contract valuation, industry competitiveness, and cost effectiveness arguments. Despite their current controversies, a case is made that contractors are cost effective given their inherent flexibility. The argument becomes stronger after considering the military's relevant alternatives to using private military companies.

**KEYWORDS:** Outsourcing in the Department of Defense, Private Military Company, Contractors on the Battlefield

### **A COMPARISON OF THE NAVY AND THE AIR FORCE BUDGETING AND EXECUTION PROCESS FOR AVIATION FUEL (AVFUEL)**

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**Daniel R. Mack-Lieutenant, United States Navy**

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**Samual P. Shimp-Captain, United States Air Force**

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

This research project provides background and explores issues related to management of Aviation Fuel (AVFUEL), Cost Per Flying Hour (CPFH), and the overarching Flying Hour Programs (FHP) for the Navy and the Air Force. Due to the variables used in the CPFH formulation and the complexity of flying hour budget formulation and execution, each armed service uses somewhat differing procedures in managing the FHP. This research focuses primarily on aircraft flying hours, and specifically the management of Aviation Fuel (AVFUEL). This research provides an overview to explain how the CPFH is used, as well as analysis of the tasks of monitoring and managing the FHP based on the continuous flow of execution information from operating units. Also provided is a detailed evaluation of the CPFH concept in practice and a description of the structure used for each service, comparing the two. The research project focuses on the importance of management and decisions made at the Air Type Commander (TYCOM) and Major Command (MAJCOM) levels. The project reviews the Air Force process of FHP management centralization, in part to determine whether there are lessons from the Air Force approach that may be applicable to improving FHP formulation and execution in the Navy.

**KEYWORDS:** AVFUEL, CPFH, Centralization, CRIS, Flying Hours, PPBES, OP-20

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## **ANALYSIS OF SECURITY CONTRACTORS IN DEPLOYED ENVIRONMENTS**

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The unexpected strength of the Iraq insurgency has created an unstable and unsafe environment that makes it difficult for U.S. forces to operate and transfer security responsibilities to the new Iraqi government. To deal with this issue, the Department of Defense (DoD) has deemed it necessary to increase the role of private military contractors, rather than increasing the total number of military troops on the ground. Several dilemmas arise contractually when privatized military firms are hired to conduct military functions. This Master of Business Administration (MBA) project analyzes consequences of the DoD decision to outsource security contractors in Iraq. Specifically, authors review the contracting and legal ramifications of outsourcing this inherently governmental occupation. This research 1) discusses the strengths and weaknesses of the government's decision to outsource commercial contractors for security force operations in Iraq, 2) identifies and discusses any potential trends that impact contractual and legal issues involving security force contractors, and 3) lays the foundation and provides recommendations for future analysis of relations between security force contractors and the government.

**KEYWORDS:** Security Contractors, Private Military Firms, Iraq

## **SOLVING WARFIGHTER CAPABILITY REQUIREMENTS THROUGH VENTURE CAPITAL**

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The objective of this project is to explore the concept of Venture Capitalism (VC) as a vehicle for technology transference. Currently, the United States Air Force (USAF) relies on an inefficient timeline for research and development to acquire new technologies. In an effort to improve efficiency in technology development, the USAF needs to adopt alternative processes such as VC.

This project explores the use of a VC firm, technology transference, USAF policies and procedures, required USAF infrastructure, and funding. Ultimately, the product from this research is an implementation plan for a USAF VC initiative.

**KEYWORDS:** Venture Capital, VC, Technology Transference, VAPR, IRR, Model, Funding

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### **PROCESS IMPROVEMENT AT THE AIRCRAFT INTERMEDIATE MAINTENANCE DETACHMENT (AIMD) AT NAVAL AIR STATION WHIDBEY ISLAND**

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**Terence Noel C. Mejos-Lieutenant, United States Navy**

**Master of Business Administration-December 2006**

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This project focuses on the J52-P408 engine repair process and the implementation of the “AIRSpeed” program at the Aircraft Intermediate Maintenance Department (AIMD) at Naval Air Station Whidbey Island (NASWI), Washington. The project is conducted with the sponsorship and assistance of Program Executive Office Ships (PEO SHIPS) and Program Executive Office Integrated Warfare Systems (PEO IWS). The goal of this project is to analyze how the leadership of AIMD incorporated Theory of Constraints (TOC), Just in Time (JIT), Lean, Six-Sigma, and Lean-Six-Sigma methodologies in the engine repair process, and to examine the effects of their application in relation to repair cycle time and overall readiness level. This report describes and compares earlier and current AIRSpeed engine removal and repair processes, starting from the flight line to the ready for issue (RFI) pool at AIMD. Using simulation modeling tools and private industry production and inventory management philosophies, recommendations are made for further improvement in the repair process. Authors examine how the application of AIRSpeed processes contributes to the mission readiness of the United States Navy and Marine Corps’ fleet of EA-6B Prowler aircraft, while reducing operation and maintenance cost.

**KEYWORDS:** AIRSpeed, Lean, Six-Sigma, Engine Repair Process, Repair Cycle Time, Value Stream Mapping, Process Improvement and Arena Simulation

### **OFFICE OF THE CHIEF OF NAVAL OPERATIONS (OPNAV) N432D RESPONSIBILITIES AND IMPACT ON BUDGET FORMULATION FOR THE NAVY FLYING HOUR PROGRAM**

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Office of the Chief of Naval Operations (OPNAV) N432D serves as the Navy’s resident expert on the Flying Hour Program (FHP) and the chief agent in the management of FHP funding. The Navy utilizes the Department of Defense Planning, Programming, Budgeting, and Execution System (PPBES) to provide the resources for the FHP. Due to the complexity of the PPBES and the FHP management procedures and processes, new officers assigned to N432D spend a large portion of their first year on the job merely observing and learning their jobs, which results in reduced productivity.

The purpose of this professional report is to identify the responsibilities, key knowledge areas, and tasks of N432D aviation FHP officers and to analyze their role and impact in the budget formulation process for the Navy FHP. This document provides a one-source reference for new members of N432D to improve their productivity in their first year on the job.

**KEYWORDS:** Flying Hour Program, PPBES, Naval Aviation, Flying Hour Projection System

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### **CAPITALIZING ON COMMERCIAL-ITEM DESIGNATION PROVISIONS OF FEDERAL ACQUISITION REGULATION (FAR) 13.5: GETTING THE MOST FROM LIMITED RESOURCES**

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The past decade has seen a significant change in business practices within the federal contracting arena. Acquisition reform initiatives have fundamentally transformed the protocols and processes the federal government utilizes to procure billions of dollars' worth of goods and services every year. Reforms provided under the Federal Acquisition Streamlining Act (FASA), the Federal Acquisition Reform Act (FARA), and the Services Acquisition Reform Act (SARA), along with ensuing regulatory provisions in the Federal Acquisition Regulation (FAR), have created a more business-to-business-like contracting methodology. One such methodology is the FAR 13.5 Test Program for Commercial Items. FAR 13.5 allows the utilization of Simplified Acquisition Procedures (SAP) for all commercial-item designated goods and services up to and including \$5.5 million. The FAR 13.5 regulatory provision has tremendous potential to alleviate field contracting activities' work-in-process backlogs, improve cycle-time, reduce transaction costs, and increase customer satisfaction. Specifically, the objective of this research study is to determine the extent to which the Navy's Fleet and Industrial Supply Center (FISC) activities are capitalizing on the legislative provisions and regulatory provisions of FAR 13.5 and to make specific recommendations for improving the full utilization of the FAR 13.5 commercial-item designation provisions.

**KEYWORDS:** Federal Acquisition Streamlining Act, FASA, Federal Acquisition Reform Act, FARA, Services Acquisition Reform Act, SARA, Federal Acquisition Regulation, FAR, FAR 13.5, Simplified Acquisition Procedures, SAP

### **THE DEVELOPMENT OF A BUSINESS CASE ANALYSIS FOR THE ACQUISITION OF THE AGILE RAPID GLOBAL COMBAT SUPPORT SYSTEM USED FOR THE UNITED STATES MARINE CORPS' GROUND EQUIPMENT**

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**Daniel A. Nussbaum, Department of Operations Research**

Agile Rapid Global Combat Support (ARGCS) system is a new Automatic Test System being developed through the Department of Defense's Advanced Concept Technology Demonstration program. This business case analyzes ARGCS' benefits for the Marine Corps as an option to replace their current Automated Test Systems for ground equipment. The business case analyzes the Marine Corps' current systems, specifically the Marine Corps' Third Echelon Test Set, and quantifies the relevant differences between these systems and the Agile Rapid Global Combat Support System.

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

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# **MASTER OF BUSINESS ADMINISTRATION**

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## **PROMOTING ENTERPRISE SUCCESS WITHIN TEAM BASED ENTITIES IN HIERARCHICAL ORGANIZATIONS: A STUDY OF BUSINESS SYSTEMS MODERNIZATION (BSM) INITIATIVES AT DEFENSE SUPPLY CENTER RICHMOND (DSCR)**

**Trent Kalp-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

**Cory Schemm-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

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

Organizational change is extremely challenging within hierarchical public organizations. Hierarchical structures, deeply embedded cultures, and employee resistance are some of the characteristics that impede an organization's ability to transform and implement change. In February 2005, Defense Supply Center Richmond (DSCR) began a transformational process entitled Business Systems Modernization (BSM) to improve organizational performance by providing higher value to its customers, attaining better financial performance, and maintaining sales and economies of scale. The purpose of this MBA professional report is to establish and test a theoretical change model applicable to public hierarchical organizations implementing performance related change efforts, such as Key Performance Indicators (KPIs). Specifically, this professional report identifies organizational change elements and methodologies necessary for successful transformation initiatives. By identifying and validating hypothesized change model variables, this professional report develops a change model that can provide DSCR and other public hierarchical organizations with effective methods for predicting desired outcomes. Additionally, this professional report provides DSCR with recommendations to improve employee adoption, acceptance, and application of recently implemented KPI performance measurements.

**KEYWORDS:** Organizational Change, Organizational Transformation, Hierarchical Organizations, Diagnostic Change Model, Change Management, Organizational Climate, Key Performance Indicators

## **DISASTER RESPONSE CONTRACTING IN A POST-KATRINA WORLD: ANALYZING CURRENT DISASTER RESPONSE STRATEGIES AND EXPLORING ALTERNATIVES TO IMPROVE PROCESSES FOR RAPID REACTION TO LARGE SCALE DISASTERS WITHIN THE UNITED STATES**

**Jerry A. King-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

**Joshua H. McKay-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

**Advisors: Ronald B. Tudor, Graduate School of Business and Public Policy**

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Considerable public scrutiny has been focused on the federal government's, especially the Federal Emergency Management Agency's (FEMA), supposed inadequate, misdirected, and slow response to the acquisition needs required for responding to the aftermath of Hurricane Katrina. This seemingly failed response quite possibly cost the federal government billions in wasted taxpayer dollars and has affected the livelihood of thousands. Analyzing what went wrong and examining available acquisition concepts, organizations, processes, and technologies that could be leveraged for future disaster responses is the focus of this MBA project. The project's product involves providing proposed solutions to assist FEMA's acquisition mission, along with recommended technologies for executing these solutions.

**KEYWORDS:** Hurricane Katrina, Disaster Contracting, Emergency Management, Emergency Response, Federal Emergency Management Agency, Department of Homeland Security, Rapid Ordering System, Online Reverse Auctions, Telework, Global Information Network Architecture

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## **MASTER OF BUSINESS ADMINISTRATION**

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### **COST VALUATION: A MODEL FOR COMPARING DISSIMILAR AIRCRAFT PLATFORMS**

**Eric J. Long-Captain, United States Marine Corps**

**Master of Business Administration-December 2006**

**Advisors: Douglas A. Brook, Graduate School of Business and Public Policy**

**William R. Gates, Graduate School of Business and Public Policy**

The purpose of this MBA project is to investigate and provide an overview of current cost valuation methods used to compare aircraft, and then to determine if the current methods are satisfactory for comparing dissimilar aircraft platforms. The goal of the project is to develop a model using operation and support (O&S) and procurement cost inputs, together with aircraft inventory and utilization data, in order to produce a cost per unit hour for any given aircraft. A demonstration of the model's validity using aircraft and cost data from the Predator unmanned air vehicle (UAV) and the F-16 is performed to illustrate how the model can be used to aid comparisons of dissimilar aircraft platforms that perform similar missions.

**KEYWORDS:** Aircraft Valuation, Program Comparison, Cost Analysis, Cost Comparison

### **EVALUATING LEADERSHIP'S APPROACH TO IMPLEMENTING ORGANIZATIONAL CHANGE, ACROSS THE NAVAL AVIATION ENTERPRISE WITH A FOCUS ON THE DEVELOPMENT OF FLEET READINESS CENTERS**

**Jason D. Lovell-Captain, United States Marine Corps**

**Master of Business Administration-December 2006**

**Christopher M. Sacco-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

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

**Philip J. Candreva, Graduate School of Business and Public Policy**

Naval Air Systems Command (NAVAIR) is currently realigning its Aviation Maintenance infrastructure to fall under the overarching umbrella of the newly minted Naval Aviation Enterprise (NAE). This realignment calls for a new enterprise-wide strategy and structure. Hierarchies and relationships are being redefined throughout the enterprise, resulting in entirely new organizational structures functionally equivalent to industry's small business units. This realignment will result in the elimination of Intermediate level maintenance as it exists today, and presents a myriad of challenges to the fleet in the terms of achieving business efficiencies and employee relationship management. This MBA project evaluates, by survey, how effectively the U.S. Navy and Marine Corps have managed the change effort as they continue to realign their Intermediate and Depot level units under the new Fleet Readiness Center (FRC) construct.

**KEYWORDS:** Organizational Behavior, Naval Aviation Enterprise, Fleet Readiness Center, NAE, FRC

### **ANALYSIS OF NAVAL FACILITIES ENGINEERING COMMAND'S (NAVFAC) CONTRACTING PROCESSES USING THE CONTRACT MANAGEMENT MATURITY MODEL (CMMM)**

**Walter S. Ludwig-Lieutenant, United States Navy**

**Master of Business Administration-December 2006**

**Alexander M. Moore-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

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

**Leslie E. Sekerka, Graduate School of Business and Public Policy**

This study assesses the process capabilities and competencies of Naval Facilities Engineering Command's (NAVFAC) Mid-Atlantic. The assessment uses a cross-sectional questionnaire covering contracting processes and selected ethical context. The purpose of this study is to analyze NAVFAC's contracting processes, establish a baseline for contract management maturity and ethical context, and recommend target areas for improvement efforts by application of the Contract Management Maturity Model (CMMM) and the associated Contract Management Maturity Assessment Tool (CMMAT) to NAVFAC Mid-Atlantic's

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Facilities Engineering and Acquisition Department. An ethics questionnaire is administered to examine NAVFAC's ethical context.

**KEYWORDS:** Contracting, Maturity Model, Ethical Context, Ethics, Rule Bending

### **COST ANALYSIS OF OUTSOURCING AN AIR FORCE SUPPLY SQUADRON**

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**Master of Business Administration-December 2006**

**Scott D. Schofield-First Lieutenant, United States Air Force**

**Master of Business Administration-December 2006**

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

Outsourcing is a commonly used method for providing cost savings in business and the federal government. This project begins by providing background on the history, goals, and problems associated with the A-76 process. It then analyzes the financial management aspects of the Air Force's 2001 decision to outsource one of its supply squadrons to determine whether anticipated cost savings were achieved. Any costs savings or increases are analyzed to determine to what extent they exceeded expectations. If added costs came up throughout the life of the contract, the causes of these are sought and a determination made regarding whether or not they could have been anticipated in the initial contract competition and used in the initial cost comparison.

Furthermore, this research lays a foundation for building a body of knowledge to be utilized in future research regarding the federal A-76 or competitive sourcing practices and procedures, from which overarching conclusions of federal outsourcing can be drawn, including strengths and weaknesses of the procedures currently utilized.

**KEYWORDS:** Outsourcing, A-76, Cost Savings

### **APPLICATION OF A NETWORK PERSPECTIVE TO DEPARTMENT OF DEFENSE (DOD) WEAPON SYSTEM ACQUISITION: AN EXPLORATORY STUDY**

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**Master of Business Administration-December 2006**

**Advisors: Nancy C. Roberts, Department of Defense Analysis**

**David F. Matthews, Graduate School of Business and Public Policy**

One of the foundations of military command and control is that authority must match responsibility. Yet, in weapon system acquisition, a program manager is responsible for delivering capabilities to the warfighter without full control of the resources he needs to carry out this task. Successful program managers recognize their dependencies upon other actors and execute their programs using a network with a common goal of enhancing a specific warfighting capability. A hierarchical chain of command still exists, but the network enables the actors to carry out their objectives in an efficient and effective manner. This report describes how acquisition process purportedly works in hierarchical terms. It also introduces a process model to describe the set of activities actually used and the actors who are required to collaborate to deliver capabilities to the warfighter. The analysis of those activities between actors reveals that weapon system acquisition behaves like a network. Describing acquisition in network terms allows those involved in weapon system acquisition oversight, policy, and practice to have new insights and measurement tools to understand how to improve the weapon systems acquisition process.

**KEYWORDS:** Weapon System Acquisition Process, Acquisition Stakeholders, Network Analysis, Acquisition Organizational Analysis, Acquisition Strategy



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# **MASTER OF BUSINESS ADMINISTRATION**

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## **DEFENSE MERGERS AND ACQUISITIONS: IN THE NAME OF EFFICIENCY**

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**Master of Business Administration-December 2006**

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Over the past 20 years, the Department of Defense (DoD) has experienced a precipitous decline in budgets relative to Gross Domestic Product (GDP) and a drastic decline in the number of suppliers in the defense industry. As a result of these developments, the DoD must make well-educated decisions in the future to ensure the optimal use of appropriated funds and to determine the proper industrial organization in the defense industry. A historical analysis of past mergers and acquisitions (M&As) is critical to understanding the impact of consolidation of the defense industry on the cost of DoD weapon systems. This thesis develops the first electronic database containing the historical costs of DoD Major Defense Acquisition Programs (MDAPs). The MDAP Financial Database contains the cost data of MDAPs from the Selected Acquisition Report (SAR) summary tables for the past 26 years, the name of the contractors involved with the weapon systems during the cost report periods, a classification of the weapon system, and the weapon system's North American Industry Classification System (NAICS) industry code. This thesis also identifies the importance of M&A research, and provides preliminary analysis describing the DoD historical acquisition environment and future research that would benefit the DoD, including portfolio analysis.

**KEYWORDS:** Mergers and Acquisitions, Selected Acquisition Reports, Major Defense Acquisition Programs, North American Classification System

## **ANALYSIS OF NAVAL NETWAR FORCENET ENTERPRISE: IMPLICATIONS FOR CAPABILITIES BASED BUDGETING**

**Steven R. McKinney-Lieutenant, United States Navy**

**Master of Business Administration-December 2006**

**Brian T. Sandidge-Captain, United States Air Force**

**Master of Business Administration-December 2006**

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

Analysis is conducted to understand the Automated Digital Network System (ADNS), the Naval Netwar FORCENet Enterprise (NNFE), and the goals of the enterprise system. Following development of this background information and projecting how ADNS is likely to succeed in the NNFE framework, two fundamental research questions are addressed. The first question: does the enterprise system reduce the discrepancies between the Planning, Programming, Budgeting, Execution System (PPBES) and the acquisition decision process for both budgeting and defense asset acquisition? The second question: to what extent can the discrepancies and resulting problems discovered during this research project be resolved to improve national defense budgeting within NNFE and asset acquisition decision effectiveness in the Department of Defense (DoD)? Finally, the feasibility of a notional model to help a Program Executive Office (PEO) prioritize program decisions is discussed and conclusions are presented.

**KEYWORDS:** Naval Netwar FORCENet Enterprise, Automated Digital Network System, Planning, Programming, Budgeting, Execution System, Capabilities Based Budgeting

## **ASSESSING THE VALUE OF THE JOINT RAPID ACQUISITION CELL**

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

**Second Reader: Douglas A. Brook, Graduate School of Business and Public Policy**

The Joint Rapid Acquisition Cell (JRAC) was established to assist, determine, monitor, and track the fulfillment of Immediate Warfighter Needs (IWN). The primary goal of this thesis is to investigate whether the JRAC and its processes are value added to the Department of Defense (DoD) acquisition process. A

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secondary goal is to document the JRAC process and analyze its usage to date. Such analysis may be used to determine whether the Joint Rapid Acquisition Cell is the correct model for rapid acquisition and if it should be institutionalized for the Global War on Terror and beyond.

The thesis assesses the JRACs value against a baseline of existing service rapid acquisition processes. Value centers derived from Knowledge Value Added (KVA) methodologies form the basis of the assessment. The thesis concludes with recommendations for JRAC institutionalization.

**KEYWORDS:** Rapid Acquisition, Joint Urgent Operational Need, Immediate Warfighter Need, Joint Rapid Acquisition Cell

### **THE FISCAL BLANK CHECK POLICY AND ITS IMPACT ON OPERATION IRAQI FREEDOM**

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

**Second Reader: Philip J. Candreva, Graduate School of Business and Public Policy**

Congress passed declaration of war language for World Wars I and II. This language provides the military with practically unlimited resources and relaxed accountability during times of war. This “blank check policy,” while not an official policy, continued through twentieth-century wars. Toward the latter half of the twentieth century, the war powers struggle between the Legislative and Executive Branches resulted in instances of Congress under-funding war efforts and increased scrutiny of in-theater spending. In spite of the under-funding, the Department of Defense continued to extend the blank check policy of spending to the combatant commander. The shortfall of funding was filled by reprogramming annual appropriations for Vietnam, contingencies of the 1990s, and the current war in Iraq.

This thesis builds on the studies of Walter Rundell, Leonard Taylor, and William Rogerson, who pioneered the critique of financial management in combat. Building on these works, the resource management environment of Multi-National Force-Iraq is critically analyzed. The negative consequences of excessive spending are discussed. These consequences are linked to the strategic mission and the support of the American people, which ultimately determines the funding levels of the DoD. Benefits gained in the blank check policy are compared to the negative consequences.

**KEYWORDS:** Supplemental Appropriation, Budget, Contingency Operations, Slack Budget Resources, Operations and Maintenance, Resource Management, Declaration of War, Goal Congruence, Blank Check, War Powers, Logistics Civilian Augmentation Program, Accounting

### **A CRITICAL ANALYSIS OF THE ACQUISITION REVIEW JOURNAL: ARE WE IN STEP WITH THE FIELD?**

**Cristina M. Miranda-First Lieutenant, United States Air Force**

**Master of Business Administration-December 2006**

**Cheronda V. Span-First Lieutenant, United States Air Force**

**Master of Business Administration-December 2006**

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The purpose of this study is to provide contributing authors with an understanding of the trends in article submission to the Acquisition Review Journal (ARJ) with regard to the types of research performed, research design, and data analysis. This research provides future contributors with insight that will improve both the quality of the ARJ and future research for the Acquisition Corps. It also provides guidance and recommendations for future research articles within the ARJ.

This study analyzes and classifies 233 articles that were published in the ARJ over the last 13 years (1994-2006). Content and statistical analyses are performed on the themes, research types, research designs, and data analysis methods employed. Moreover, trends such as educational and institutional affiliations of contributing authors are also reviewed.

The ARJ has shown some distinctive trends, which are reflected in its publication of a number of qualitative studies; however, it has also shown progress in the number of published quantitative studies.

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The academe and practitioners' contributions remained steady, while civilian contributions have been rising. These trends are in line with current recommendations of the research community. For a relatively new journal, such trends are a good representation of a growing community.

**KEYWORDS:** Acquisition Reform, Acquisition Reform Initiatives, Acquisition Review Journal, Content Analysis, Categorical Analysis, Types of Research Performed, Acquisition, Types of Research Design, Types of Data Analysis

### **EVALUATION OF SUSTAINED VALUE CREATION WITH THE DEPARTMENT OF DEFENSE'S (DOD) FINANCIAL IMPROVEMENT AND AUDIT READINESS (FIAR) PLAN**

**Robert David Patton-Lieutenant Commander, United States Navy**

**Master of Business Administration-December 2006**

**Advisors: Douglas A. Brook, Graduate School of Business and Public Policy**

**Philip J. Candreva, Graduate School of Business and Public Policy**

For over two decades Congress has made several efforts aimed at improving financial visibility throughout the federal government. Responses from the Department of Defense (DoD) have been criticized by Congress for not meeting requirements. In December 2005, the DoD released the Financial Improvement and Audit Readiness (FIAR) Plan. This plan is intended to integrate the individual efforts by DoD agencies into a coherent plan that aims to improve financial management within the Department, address Congressional mandates, and pass independent verification through audit. This analysis addresses two questions. Does the FIAR Plan create value through the integration of politics, substance, and administration? If so, can this change effort be sustained over the long-term? Previously published academic frameworks for evaluating public sector organizations are used for each question. Benefits of this include the identification of elements of value created by the FIAR Plan and providing recommendations for improving perceived benefits to stakeholders. Second, it provides an assessment of the risks to sustaining the change processes required of the FIAR Plan and includes recommendations for focus to high risk areas.

**KEYWORDS:** FIAR, Financial Improvement, Audit Readiness, Financial Reform, CFO Act, Financial Reporting, Business Transformation, Change Management, Value Management

### **COST ANALYSIS OF CIVILIAN-SAILOR SUBSTITUTION PLAN FOR ASHORE AIRCRAFT INTERMEDIATE MAINTENANCE DEPARTMENTS**

**Matthew M. Scott-Lieutenant, United States Navy**

**Master of Business Administration-December 2006**

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

**William R. Gates, Graduate School of Business and Public Policy**

This thesis provides a cost analysis of the plan to civilianize 4,355 enlisted billets at ten shore-based, aircraft intermediate-maintenance departments (AIMDs). Total cost is determined for each unit-identification code (UIC), billet, and rating. Active-duty costs are compared to government-service (GS)/wage-grade (WG) workers and comparisons are calculated across currently funded billets. Specific savings for each AIMD, rating, total projected savings, and an Excel decision-support tool are provided to aid the sponsor with decisions about which ratings or groups of ratings are to be considered under UIC to civilian substitution (civ-sub). A summary of potential sea/shore rotation impacts is also included.

The analysis reveals a potential personnel cost savings of 14.27%. When administrative and contractual costs are considered, along with the standard deviations inherent in this type of analysis, the overall cost effectiveness of civ-sub is negligible. Other effects must be considered, including active duty manpower reductions on host naval air stations, significant shore duty billet reductions, costs above and beyond personnel, and retention. Potential retention effects could eventually affect manning levels at sea and ultimately damage afloat AIMD readiness. The cost savings ashore (assuming there are savings) from implementing civ-sub will not compensate for the inability to maintain aircraft and aircraft components while deployed.

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**KEYWORDS:** Civilian Substitution, Civ-Sub, Outsourcing, AIMDs, Cost Analysis, A-76, HRCAT, NMPBS, TFMMS

### **ANALYSIS OF THE COSTS AND BENEFITS OF THE U.S. MARINE CORPS' LIGHT, ARMORED-VEHICLE DEPOT MAINTENANCE (IROAN) PROGRAM**

**John Ethan Smith-Major, United States Marine Corps**

**Master of Business Administration-December 2006**

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

**Michael Boudreau, Graduate School of Business and Public Policy**

The Inspect Repair Only as Necessary (IROAN) program is a depot-level maintenance program designed to improve the operational availability of light, armored vehicles (LAV) in the Marine Corps inventory. The policy for assigning vehicles to the IROAN program is based on age, mileage, and operating hours, with the primary criteria being time since last IROAN cycle. A cost benefit analysis is conducted using historical readiness reporting to determine if the current policy is the most cost effective among reasonable alternatives. Research indicates that the LAV fleet is actually managed on an eight year cycle, with vehicles from the operating forces receiving depot maintenance more frequently. Indications are that the average time between depot maintenance for operating force vehicles is only slightly more frequent than the optimal timing of seven years. In the course of this research it became clear that the fragmented nature of U.S. Marine Corps vehicle-maintenance data makes performing these types of studies time consuming and expensive. Consequently, the difficulties in obtaining relevant data limit the quality of information available to support the program manager's decisions.

**KEYWORDS:** Cost-Benefit, Depot Maintenance, Light Armored Vehicles

### **MIRAMAR BRIG: A CASE STUDY OF PRISON INDUSTRY**

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**Master of Business Administration-December 2006**

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

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

This MBA project is a study of the labor and industries program at Naval Consolidated Brig, Miramar, California. The brig is set to expand in fiscal year 2010 and the brig commander asked for research assistance to explore how the brig might make best use of this expansion in its labor and industries program. A tour of the base and conversation with brig administrators and supervisors indicates that the laundry area might be a worthwhile candidate for expansion. Expansion in that area could save the Navy three to four times what is being saved now by laundry operations at the brig. In addition, manpower management of the laundry function is relatively easy because training needs are low. This project recommends that the other labor and industry functions undertaken by the brig be carried on or close to their current level of operation.

**KEYWORDS:** Labor, Industry, Brigs, Operations

### **EXAMINATION OF SUCCESS FACTORS IN GETTING AND SUSTAINING CLEAN AUDIT OPINIONS WITHIN DEPARTMENT OF DEFENSE COMPONENTS**

**Eric S. Wiese-Commander, United States Navy**

**Master of Business Administration-December 2006**

**Advisors: Douglas A. Brook, Graduate School of Business and Public Policy**

**Philip J. Candreva, Graduate School of Business and Public Policy**

Over the last fifteen years, beginning with the Chief Financial Officers Act of 1990, the federal government and specifically, the Department of Defense (DoD), have engaged in an ambitious financial-reform effort. However, the Government Accountability Office, the efficiency, economy, and effectiveness experts who report to the U.S. Congress, continue to criticize the DoD's efforts at reform. This paper applies a specific

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methodology to determine if success factors, i.e., factors that substantially contribute to achieving a “clean” audit opinion within governmental organizations, exist within DoD components. This thesis seeks to answer two questions: 1) whether DoD agencies with clean, disclaimed, or qualified audit opinions display common success factors (found in prior research) that contribute to clean audit opinions, and 2) whether the DoD as a whole exhibits those success factors as well. The benefits of this study include contributing to the DoD’s efforts to achieve clean audit opinions and the benefits contained therein. Moreover, this paper seeks to extend the examination of DoD components that are required to submit independent, audited financial statements. Finally, this paper provides specific recommendations based upon common strategies of unqualified-audit DoD agencies to those DoD components that have yet to obtain a clean audit opinion.

**KEYWORDS:** Department of Defense, Audit Opinions, CFO Act of 1990, Government Accountability Office, Financial Management Reform

### **EFFICIENT USE OF RESOURCES IN THE MARINE CORPS’ OPERATION AND MAINTENANCE FUND ACCOUNT**

**Stephen F. Wildt, Jr.-Captain, United States Marine Corps  
Master of Business Administration-December 2006**

**Advisors: Carmelita Troy, Graduate School of Business and Public Policy  
Christopher Page, Lt.Col., USMC, Defense Resources Management Institute**

A descriptive analysis of resource utilization in the Operations and Maintenance, Marine Corps (O&M, MC) account. This analysis is conducted by examining unliquidated orders and reverted balances in this account. “Reverted balances” is term used to describe resources that are potentially yielded back to the U.S. Treasury at the end of the five-year expiration period for any appropriation. For purposes of familiarity and common language, the terms “reverted” and “expired” are used somewhat interchangeably with this understanding.

**KEYWORDS:** Reverted Balance Unobligated Balances, Unliquidated Balances, Inefficient Spending, O&M, MC, Operations and Maintenance

### **A COMPARATIVE ANALYSIS OF THE TRENDS IN CONGRESSIONAL CONTROL OF DEFENSE SPENDING**

**Jason L. Woodruff-Captain, United States Air Force  
Master of Business Administration-December 2006**

**Advisors: Philip J. Candreva, Graduate School of Business and Public Policy  
Lawrence R. Jones, Graduate School of Business and Public Policy**

Each year the Department of Defense prepares and submits a budget request through the President to Congress. Not only does the DoD believe that they need the resources asked for in the budget, they also request a certain level of flexibility in spending in order to meet the challenges of an uncertain future with a changing threat environment. When Congress increases their control over spending, the DoD’s flexibility in spending directly decreases. Therefore, understanding congressional control over defense through the budget is important for defense management.

Levels and trends in congressional control over defense spending have been studied in the past. The goal of this thesis is to determine if the levels and trends in congressional control of Defense spending within the post-Cold-War era are consistent with those observed in the Cold-War era. Comparative analysis through the use of graphs and statistics is the methodology used to determine the degree of consistency between time periods. Results show that the increasing trends of congressional control over defense spending observed in the Cold-War era have significantly leveled off. It seems as if Congress has reached maximum capacity to control defense spending.

**KEYWORDS:** Congress, House Armed Services Committee, Senate Armed Services Committee, Department of Defense, Control, Oversight, Micromanagement, Spending, Budget, Legislation, Hearings, Trends, Patterns

# **MASTER OF BUSINESS ADMINISTRATION**

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## **FINANCIAL ANALYSIS OF CONTRACT BERTHING**

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**Master of Business Administration-December 2006**

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

**Daniel A. Nussbaum, Department of Operations Research**

**Michael Denning, CDR, USN, Commander Naval Reserve Forces, New Orleans, Louisiana**

The purpose of this MBA project is to identify financial, manpower, and time variables in a contract-berthing budget line, and to determine the effects of the variables on cost and efficiency statistics of the budget line, given a continuance of current policy.

A contract-berthing budget line refers to the funding provided under a contract-berthing policy to reservists to cover certain lodging and meal expenses. More particularly, selected reservists (SELRES) are required to conduct drills for pay at their assigned readiness command (REDCOM), including the Naval Air Reserve (NAR) and/or Naval Air Facility (NAF). REDCOMS are typically assigned according to the facility closest to the home of residence of the SELRES. Under current Command Naval Reserves Forces Command (CNRFC) contract-berthing policy, SELRES living more than 50 miles from their assigned NAR are authorized lodging and meals expenses, in addition to their drill pay.

In this project, REDCOM statistics are analyzed to estimate the increase or decrease in funding required for a contract-berthing budget line. The current berthing process and the potential future effects on the 50-mile-radius rule of the contract-berthing policy are also examined. The data included in this MBA project were generated in pre-base realignment and closure (BRAC) 2005 decisions; therefore, analyses in this project are based on that data. Finally, based on the foregoing analyses, an assessment is made as to whether changes to the current contract-berthing policy are warranted.

**KEYWORDS:** Finance, Manpower, Time Forecasting



# **MASTER OF SCIENCE**

**Applied Physics**  
**Astronautical Engineering**  
**Combat Systems Technology**  
**Computer Science**  
**Defense Analysis**  
**Electrical Engineering**  
**Engineering Science**  
**Human Systems Integration**  
**Information Technology Management**  
**Information Operations**  
**Leadership and Human Resource Development**  
**Management**  
**Mechanical Engineering**  
**Meteorology**  
**Meteorology and Physical Oceanography**  
**Operations Research**  
**Physical Oceanography**  
**Program Management**  
**Space Systems Operations**  
**Systems Engineering**





# **MASTER OF SCIENCE IN APPLIED PHYSICS**

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## **DIRECT ELECTRIC-FIELD VISUALIZATION IN SEMICONDUCTOR PLANAR STRUCTURES**

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**B.S., Hellenic Military Academy, 1992**

**Master of Science in Applied Physics-December 2006**

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

**Advisors: Nancy M. Haegel, Department of Physics**

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

A new technique for imaging the 2D transport of free charge in semiconductor structures is used to directly map electric-field distributions in operating devices. Direct transport imaging is demonstrated in a scanning electron microscope, using an optical microscope and a high sensitivity, charge-coupled device. Transport behavior under the combined influence of both diffusion and drift is predicted by modeling the drift and diffusion in 2D, following generation at a point source. This is the first demonstration of a technique that allows the mapping of the electric field by determining not only the direction, but especially the magnitude of the electric field with high resolution. The measured results show excellent agreement with theoretical predictions simulated with COMSOL software.

The transport-imaging technique also allows measurement of contact resistance in a new way that is nondestructive and based on a two-point contact only. The technique illustrates the device's characteristics by determining the exact activation point of the diode and the deviations from an ideal I-V behavior. The method is extremely useful since the complexity and miniaturization of current devices do not allow for multiple wiring that standard four-point measurement demands.

Finally, a suggestion for further research of the effects of electromigration by using the direct transport-imaging technique is offered. The latter is a subject of high importance in electronic-device reliability.

**KEYWORDS:** Diffusion, Direct Transport Imaging Technique, Drift, Electric Field Mapping, Minority Carrier Lifetime, Minority Carrier Mobility, Semiconductors

## **ANALYSIS OF COOLANT OPTIONS FOR ADVANCED, METAL-COOLED, NUCLEAR REACTORS**

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**Second Reader: Xavier Maruyama, Department of Physics**

It is well known that any neutron-producing device generates induced radioactivity as a byproduct of its operation. In the case of nuclear reactors, the induced radioactivity includes fission and activation products. The overall focus of this study is the buildup of induced radioactivity in the coolant of metal-cooled reactors, as well as the evaluation of other physical and chemical properties of such coolants. The objectives of the thesis are twofold. The first objective is to independently calculate the generation of polonium-210 in reactors cooled by lead and lead-bismuth eutectic. The motivation for this is to address a noted lack of consensus among world researchers on the significance of Po-210 build up in lead-cooled reactors. The second objective is to evaluate the advantages and disadvantages of selected-candidate metal coolants.

In addressing both objectives, the computer code ORIGEN is used. To establish the background basis for these assessments, fundamental concepts of reactor physics are reviewed and discussed.

**KEYWORDS:** Coolant Activation, Sodium, Lead, Lead Bismuth, Small Reactors, SSTAR, Liquid Metals

### **OBJECT-ORIENTED, PROGRAMMABLE, INTEGRATED-CIRCUIT UPGRADE AND EVALUATION FOR AUTONOMOUS GROUND VEHICLE**

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The objective of the small-robot technology (SMART) initiative at the Naval Postgraduate School is to develop robots for military uses. To this end, the work consists of utilization of a small, low-power, object-oriented, programmable, integrated-circuit (OOPIC) microcontroller, integration and testing of sensors with the OOPIC, and development of a new standard for wireless communications with the XBee wireless suite. Several tests are conducted, including range and time operation tests for wireless communications and comparison tests between the OOPIC microcontroller and the legacy BL2000 microcontroller. Results demonstrate long battery life for the electronics of the robot, as well as ranges exceeding high power modems. However, the OOPIC does prove inefficient at times, regularly locking up when not initiated properly, and is limited by lower processing power and inability to interpret some forms of incoming data. These flaws limit the goals of the robot to have GPS-based navigation and a proportional, integration-derivative-based navigation system, but could prove ideal for other, confined environments or with the BL2000 microprocessor. Ideally, the BL2000 could take advantage of the OOPIC robust I2C and sensor processing capabilities to lift the processing burden. There is discussion of future applications and further opportunities for research.

**KEYWORDS:** Robotics, OOPIC, Microprocessor

### **IMAGING OF 3.4 THZ, QUANTUM-CASCADE LASERBEAM USING AN UNCOOLED, MICROBOLOMETER CAMERA**

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The employment of terahertz (THz) technology for applications including improvised, explosive devices and concealed-weapons detection is a rapidly growing field of research. THz waves do not pose a health hazard as do x-rays, and as such can be used for the imaging and detection of certain cancers. To date, however, most detectors are highly sophisticated, bulky systems that require extensive cooling in order to provide a signal-to-noise ratio high enough for detection. A detection system that is simple in operation and uncooled is highly desirable, and is the focus of this research.

In this thesis, operation of a 3.4 THz quantum-cascade laser is achieved using a closed-cycle cryostat and nanosecond pulse generator with impedance-matching circuitry. The laser beam is imaged in real time using an uncooled, microbolometer, infrared camera, typically used in the far-infrared wavelength band (8-12  $\mu$ m). The preliminary findings offer potential for development of a compact THz imaging system for applications involving concealed-object detection.

**KEYWORDS:** Terahertz, Quantum Cascade Laser, Microbolometer, Uncooled Detector

### **SPECTROSCOPIC IMAGING WITH UNCOOLED, MICROBOLOMETER, INFRARED CAMERA AND STEP-SCAN, FOURIER-TRANSFORM, INFRARED SPECTROMETER**

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The purpose of this research is to explore the feasibility of spectral imaging using a microbolometer infrared camera and a step-scan, Fourier-transform, infrared spectrometer (FTIR). Spectral imaging is usually carried out using cryogenically cooled, semiconductor-based, focal-plane arrays (FPAs), which provide higher sensitivity as compared to microbolometer FPAs based on thermal sensors. The key advantage of spectral imaging is the ability to extract spatial variations of spectral information. During measurement, images are collected as the moving mirror of the FTIR steps across the zero crossings of the on-axis portion of the interferogram. The preliminary data indicate that interferograms can be successfully recorded using the microbolometer camera, and that data from individual pixels of the camera show the expected intensity profile. The interferograms from the individual pixels are inverse Fourier transformed to recover the intensity of the broadband infrared source of the FTIR at different pixels. The initial data shows relatively low signal-to-noise ratio, indicating that signal averaging is necessary at each mirror step by collecting several images, as well as optimizing the image-collecting optics.

**KEYWORDS:** Spectrometer, Fourier Transform, Infrared, Spectroscopic Imaging, Interferogram, Focal Plane Array

### **IMPROVISED-EXPLOSIVE-DEVICE PLACEMENT DETECTION FROM A SEMI-AUTONOMOUS GROUND VEHICLE**

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Improvised explosive devices (IEDs) continue to kill and seriously injure military members throughout the Iraqi theatre. The autonomous ground vehicle (AGV) seeks to identify the human presence placing the IED and then report that contact to a unit of action. This research develops a semi-autonomous platform that can navigate to waypoints, avoid obstacles, investigate possible threats, and then detect motion that triggers a visual camera. The information is then relayed back to the user and can trigger a variety of actions. AGV has been tested in a numerous environments with a wide range of success. It is limited by the communication range from its standard 802.11G router and non-continuous availability of the global positioning system. Terrain with extensive peaks and valleys is not ideal for the current platform. However, for detecting the human presence that is consistent with IED placement, AGV is well suited. The Dynamic C code utilized onboard the computer is included as an appendix.

**KEYWORDS:** Robotics, Autonomous, Human Presence, Improvised Explosive Device

### **DIRECT IMAGING OF MINORITY-CHARGE-CARRIER TRANSPORT IN TRIPLE-JUNCTION SOLAR-CELL LAYERS**

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An optical, contact-free method for measuring minority-carrier diffusion lengths is developed and demonstrated for a range of semiconductor materials used in high efficiency triple-junction solar cells. This method uses a scanning electron microscope (SEM) coupled with an optical microscope. The diffusion lengths, combined with minority carrier lifetime measured via time-resolved photoluminescence, allow for the computation of minority-charge-carrier mobility.

The technique uses images to extract diffusion length measurements from GaAs, InGaAs, and InGaP heterostructures at different SEM beam energies and probe currents. Excellent correlation between measurements shows the reproducibility of this technique. Diffusion lengths from 2-63 microns are measured in a variety of GaAs, InGaAs, and InGaP samples. Effects of alloy ordering, doping, and lattice matching are investigated.

Several areas for further research are offered, including detailed radiation-damage mapping of solar cell layers. Further anisotropic studies of the solar cell layers are suggested to investigate the directional dependence of diffusion length within the InGaP heterostructures. Finally, new and emerging solar-cell materials would benefit from this technique, allowing for the complete characterization of minority-charge transport properties before growing an entire solar cell.

**KEYWORDS:** Solar Cells, Triple Junction Solar Cells, Semiconductor, Diffusion Length, Minority Charge Carrier, Transport Imaging, Minority Carrier Mobility

### **DESIGN AND ANALYSIS OF SIDE-LOOKING SONAR EXPERIMENTS**

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This research concerns the design and analysis of different side-looking sonar experiments in order to satisfy different operational requirements. The different designs and analysis are done via computer simulation. Side-looking sonar (also known as side-scan sonar) is known for very high quality, high resolution, ocean-bottom imaging. Hence, it is used for bathymetric surveys, commonly called seafloor mapping. It is able to rapidly survey large ocean areas for bottom and suspended sea-mines or other kinds of threats. Another operational aspect of these systems is that they allow autonomous underwater vehicles (AUVs) to conduct operations, mostly in shallow water and near land. Thus side-looking sonar can be a very useful device in littoral warfare operations. This research defines the basic parameters that rule the operation of side-looking sonar and, furthermore, analyzes various aspects that affect the performance of these parameters. Special focus is given to the various operational requirements and conditions that a designer or a user may encounter in realistic situations. Toward that end, many numerical examples are presented. Moreover, this research tries to indicate the various problems that may arise when a side-looking sonar operates in its near-field region, and suggests certain solutions. The active-sonar equation and its factors are also explained and evaluated for a realistic example of mine detection.

**KEYWORDS:** Side-Looking Sonar, Side-Scan Sonar, Ocean Bottom Imaging

## **PERFORMANCE ANALYSIS OF IEEE 802.11G RECEIVERS WITH ERASURE DECODING TO MITIGATE THE EFFECTS OF PULSE-NOISE INTERFERENCE**

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This thesis examines the performance of IEEE 802.11g wireless, local-area-network (WLAN) standard receivers when the signal is transmitted over a frequency-selective, slowly fading Nakagami channel in a pulse-noise interference environment when errors-and-erasures Viterbi decoding is used. The different combinations of modulation (both binary and non-binary) and convolutional code rate specified by the WLAN standard are examined. The performance obtained with errors-and-erasures decoding (EED) is compared with the performance obtained with errors-only hard decision Viterbi decoding (HDD), as well as that obtained with soft decision Viterbi decoding (SDD) for binary modulation, while for non-binary modulation, EED performance is compared with HDD performance. It is found that EED can significantly improve performance under some conditions when pulse-noise interference is present.

**KEYWORDS:** IEEE 802.11g WLAN Standard, Nakagami Fading Channel, Hard Decision Decoding, Errors-and-Erasures Decoding, Soft Decision Decoding, Pulse-Noise Interference



# **MASTER OF SCIENCE IN ASTRONAUTICAL ENGINEERING**

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## **STUDY OF A NOVEL IONIZER CONFIGURATION FOR THE ION THRUSTER**

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Micro-satellites often require the adaptation of existing propulsion systems. Electric propulsion thrusters are perhaps the best candidates to meet these needs, and ion engines are among the most scalable. Miniaturizing the ion engine will require novel concepts for the ionizer, with perhaps novel propellants. microelectromechanical systems, nanotechnology, and other technological advances are expected to impact on new designs.

This work shows that the ionization of argon, which is an alternative fuel to xenon, can be achieved at low voltages by utilizing micro-structured electrode (MSE) Arrays. Copper-clad sheets separated by a dielectric material (fiberglass-laminate, epoxy-resin system, combined with a glass-fabric substrate) of varying thickness (0.1 mm to 0.4 mm) form the discharge electrodes in the MSE arrays. The wafers are drilled with an array of holes, and this geometry serves to concentrate the electric field between electrodes, enhancing electron emission at the cathode. Minimum breakdown voltages between 240 and 280 volts at pressures of around 100 mTorr (0.133N/m<sup>2</sup>) are consistently obtained, with arrays of hole diameter ranging from 300 to 500  $\mu$ m. These results are consistent with conventional Paschen-curves with two empirical constants that arise from the unconventional geometrical arrangements and from the different material properties.

**KEYWORDS:** Ion Propulsion, Ion Engine, MSE array, Paschen Curve, Ionizer

## **DESIGN OF A PREMIXED, GASEOUS, ROCKET-ENGINE INJECTOR FOR ETHYLENE AND OXYGEN**

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A premixed, gaseous, rocket-injector is designed and successfully operated over a limited range of fuel-rich operating conditions for the purpose of soot modeling for ethylene and oxygen mixtures. The injector has the advantage of delivering a homogenous mixture to the combustion chamber, lower soot production, and higher performance potential by removing the fuel-atomization process, which affects the combustion process and is inherent for non-premixed injectors. The premixed injector is operated at oxygen-fuel ratios from 1.0 to 1.8 with a mass flow of 0.024 kg/sec achieving a chamber pressure of 76 psi without propensity of flashback for 0.032" injector orifices. Increased mass flow rates of 0.027 kg/sec are achieved by increasing the injector orifice diameters to 0.0625", which produces a chamber pressure of 127 psi and a characteristic exhaust velocity efficiency of 90.1 %. Flashback is eventually observed at an oxygen-to-fuel ratio of 1.2, where the pressure drop across the injector is less than 388.6 kPa and the bulk mixture velocity through the injector orifices is approximately 90 m/s. Maintaining bulk velocity sufficiently above this value should prevent flashback from occurring, but will likely need to be characterized for additional orifice diameters and pressure differentials.



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# ASTRONAUTICAL ENGINEERING

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**KEYWORDS:** Premixed Engine, Premixed Injector, Gaseous Rocket Engine, Ethylene, Oxygen, C Star Efficiency, Carbon Soot, Soot Modeling

## **BALLISTIC-MISSILE-TRAJECTORY ESTIMATION**

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Angles measurements from optical systems are the primary source of data for maintaining the orbits of high-altitude satellites. Radar measurements are used primarily for low earth orbit (LEO) satellites. Recently it has been shown that the accuracy of the orbit updates using only optical system angles-only data is just as good, if not better, than the performance from radar systems for LEO satellites. The purpose of this thesis is to investigate the use of optical angles data with and without laser-ranging data in determining the trajectories of missiles. Analytical Graphics, Inc.'s satellite tool kit is used to model the trajectory of a ballistic missile. Several scenarios are developed for determining the orbit when acquired by sensors providing various combinations of range, range rate, and angles data. It is found that the combination of range, azimuth, and elevation sensor data yields an orbit determination that has enough merit to be called accurate. The error of the orbit determined by the angles-only data is two orders of magnitude larger than the error of the range-and-angles measurement.

An analysis of what would happen if the sensors could only track to the maximum altitude of the orbit is also completed. As assumed, the known position of the object-drifts range from minimal to significant, predicated on the final known position. This is indicated by the error ellipsoid. It is again found that the combination of range, azimuth, and elevation sensor data until the maximum altitude yields an orbit determination that has enough merit to be called accurate.

Also considered is the addition of a second sensor that has the capacity to always track range, azimuth, and elevation to increase the time that is afforded to track the object, increasing the overall accuracy of the orbit determination. It is found that the addition of a second sensor increases the fidelity of the angles-only measurement such that the combination of azimuth and elevation sensor data yields an orbit determination that has enough merit to be called accurate.

**KEYWORDS:** Telescope, Orbit Determination, Missile Trajectory, Highly Eccentric Orbit, Orbit Determination Tool Kit, Satellite Tool Kit, MSSS, Reentry Vehicle, Orbit Prediction

## **RAPID-MOTION PLANNING AND AUTONOMOUS OBSTACLE-AVOIDANCE FOR UNMANNED VEHICLES**

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This work introduces the use of optimal control methods for path planning and control of autonomous vehicles in an obstacle-rich environment. Traditional techniques harbor non-optimal, closed architectures primarily derived at a time when computational complexity could significantly hinder overall system performance. Advancements in computing power, miniaturization, and numerical methods permit the utilization of online, optimal-path planning and control, thereby improving system flexibility and autonomy. The backbone of this concept is state-of-the-art optimal-control techniques involving pseudospectral methods and sequential quadratic programming. Although this research focuses on a robotic car or unmanned ground vehicle (UGV), several systems, including an unmanned aerial vehicle (UAV) and a pendulum on a rotational base, are detailed for the purpose of illustrating the technique's modularity.

With respect to the UGV, optimal-control methods permit the optimization of maneuver parameters while accounting for complex vehicle kinematics and workspace obstacles, represented as dynamic and path constraints, respectively. The path constraints are modeled such that an obstacle of any shape or size can be included. Maneuvering trajectories are first generated in an open-loop architecture, followed by an application of these same techniques in feedback form. Lastly, model fidelity is increased to improve control over vehicle behavior and closed-loop performance and a local-knowledge scenario is evaluated.

**KEYWORDS:** Optimal Control, Trajectory Optimization, Path Planning, Autonomous Ground Vehicles, Real-Time Optimal Control, DIDO, Pseudospectral Methods Application

## **EVALUATION OF STRAIGHT- AND SWEPT-RAMP OBSTACLES ON ENHANCING DEFLAGRATION-TO-DETONATION TRANSITION IN PULSE-DETONATION ENGINES**

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The use of detonations to achieve thrust in pulse-detonation engines (PDEs) offers significant advantages in efficiency, simplicity, and versatility. An enabling mechanism for practical PDE implementation will likely utilize an efficient deflagration-to-detonation transition (DDT) process. This method simplifies detonation generation, but the required length is prohibitive in many applications and limits the frequency of repeatability. Obstacles have historically been employed to minimize the DDT distance, but often result in significant total-pressure losses that degrade the delivered efficiency advantages of PDEs. This thesis explores the use of straight and swept ramp obstacles to accelerate DDT while minimizing the overall pressure losses. Computer modeling examines three-dimensional disturbances caused by such obstacles. Experimental tests measure combustion shockwave speed, flame velocity, and flame front interactions with obstacles. Evaluations are completed for several straight ramp obstacle configurations in a modeled two-dimensional flow. The placement of consecutive ramps results in flame acceleration accompanied by significant pressure spikes approaching 500 psi. Although detonation is not verified across the instrumented section, experimental data proves that straight ramp obstacles successfully accelerate the DDT process. Computer modeling predicts that swept ramps may be even more effective by introducing streamwise vorticity with a relatively low-pressure drop.

**KEYWORDS:** Pulse Detonation Engines, PDE, PDE Ignition, PDE Initiation, Ramp, Ramp Injectors, Straight Ramp, Swept Ramp, Swept Ramp Injectors

## **APPARATUS FOR STUDY OF ION-THRUSTER PROPELLANT IONIZATION**

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Electric propulsion thrusters are considered to be candidates for micro-satellites; ion engines are among the most scalable. Miniaturizing the ion engine will require novel concepts for the ionizer. Microelectromechanical systems (MEMS), nanotechnology, and other new technologies are expected to have an impact here. This thesis explores the use of these technologies to enable a new design for ion-thruster, propellant ionization. An ideal approach, using expensive fabrication processes, is first described. This approach could prove to be a good method for testing and for the collection of precise data.

A cost-effective approach, on which this testing is based, is then discussed in detail. After assembling a facility that uses existing vacuum systems and available instrumentation, miniature discharge geometries consisting of commercial 2"x2" copper-clad wafers are manufactured and tested. Three nominal insulator thicknesses are used, 0.005", 0.010", and 0.115". The wafers are each drilled with 9 equal wholes of

diameters 300, 400, and 500  $\mu$ m. A total of 12 wafers are tested (including 3 widths without holes for a baseline) for the breakdown voltage as a function of argon pressure in the range of 10 to 1000 mTorr. Results indicate that argon breakdown may occur in the holes consistent with the classical Paschen curves.

**KEYWORDS:** Ion Propulsion, Ion Engine, MSE Array, Paschen Curve, Ionizer

# **MASTER OF SCIENCE IN COMBAT SYSTEMS TECHNOLOGY**

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## **DOPPLER-ONLY, SYNTHETIC-APERTURE RADAR**

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Synthetic-aperture radar (SAR) had commonly been performed using high-range resolution data. This thesis is a proof-of-concept that the imaging process can be performed using high-doppler resolution data. The system requires a simple-continuous-wave transmitter, and the signal returns are confined to a narrow band.

High-doppler resolution data is collected along an isodoppler line for different perspectives of the target. This data, a sinogram, is equivalent to taking the radon transform of the target. The Fourier transform of the sinogram from each perspective (at an angle  $\theta$ ) gives a slice of the two-dimensional transform subtending an angle  $\theta$  with the axis, with equally distributed points along the line. This results in a higher density of points near the center. Some form of weighting is necessary. This weighting is part of the filtered-back-projection algorithm to determine the inverse radon transform of the sinogram. The back-projection portion is a simple redistribution of data back along the original projection line.

Images are modeled by delta functions to test the above algorithm. The main points noted are that the reconstructed image is a scaled version of the original image, and that the quality of the image improves when more perspectives of the target are taken.

**KEYWORDS:** High Resolution Doppler, Radar Imaging

## **VARIABLE-RESOLUTION DIRECTION-FINDING USING THE ROBUST, SYMMETRICAL- NUMBER SYSTEM**

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A digital implementation of a phase-sampling interferometer antenna system based on the robust, symmetrical-number system (RSNS) is built using commercial, off-the-shelf items. The RSNS-based direction-finding (DF) system uses short baselines to achieve a high resolution DF capability in a physically compact system for use as stand-in sensors on unmanned aerial vehicles. The RSNS inherent integer Gray-code property minimizes the possible encoding errors and adds a robustness to the accuracy of the estimated angle of arrival (AOA).

A digital architecture using quadrature demodulators and real-time controllers provides greater flexibility for signal processing and allows for the implementation of a new virtual-spacing algorithm. The virtual spacing concept changes the RSNS moduli values to implement a virtual antenna spacing without having to physically change the antenna element spacing. This enables higher resolution DF in circumstances where the signal-to-noise Ratio (SNR) is high enough to provide error-free coding of the AOA.

Two four-element, digital, three-channel, interferometer prototype systems are constructed and tested in the Naval Postgraduate School anechoic chamber. The first antenna array is designed using pair-wise relatively prime (PRP) moduli. When an extension of the virtual-spacing concept for application to N-channel systems is successfully resolved, a second three-channel array is built using non-PRP moduli for evaluating the performance of the virtual-spacing concept. The simulated and experimental results, hardware implementation, and testing procedures are presented in this thesis. Results for the first array show that the RSNS-based DF system is able to provide 0.7 degree RMS resolution with a baseline of 66 cm. For the second virtual-spacing array, the short physical baseline of 14 cm is sensitive to noise and antenna-spacing errors.

**KEYWORDS:** Direction Finding, Robust Symmetrical Number System, Variable Resolution, Transmitter, Receiver, COTS, Quadrature Modulator, Quadrature Demodulator, High Resolution

### FUSION OF NIGHT VISION AND THERMAL IMAGES

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Night vision and thermal images are extensively used in military operations, as they help in mission planning and executions tasks. Image fusion effectively combines information present in both types of image. This research explores two wavelet-based, image-fusion approaches for night vision and thermal images; namely, wavelet transform fusion and region-based fusion. Morphological methods designed to improve the image segmentation step are considered to improve image contrast, and a global image-quality index is applied to investigate the information content improvement resulting from the fusion process. Finally, a MATLAB-based graphical user interface is designed to assist the user in evaluating the benefits of the fusion process. Results show that the selection process is able to narrow to the best-fused image with satisfactory accuracy.

**KEYWORDS:** Image Intensifiers, Thermal Image, Digital Image Processing, Wavelet Transform Fusion, Region-Based Fusion

### WIRELESSLY NETWORKED, OPPORTUNISTIC, DIGITAL-PHASED ARRAY: SYSTEM ANALYSIS AND DEVELOPMENT OF A 2.4 GHZ DEMONSTRATOR

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The concept of a wirelessly networked, opportunistic, digital phased array radar brings about the added advantages of stealth, enhanced survivability, and maximum maneuverability. The array elements are spread over a wide range of locations on the ship's hull and superstructure, and the local oscillator (LO) and data/control signals are wirelessly transmitted to and from a central computer processor, which also performs as the digital beam former.

As part of the ongoing research effort, this thesis focuses on the hardware and software development of a 2.4 GHz two-element array demonstrator. A system analysis of a generic distributed array radar is conducted and some key parameters pertaining to the transmit/receive (T/R) module and an eight-element array radar are calculated. In addition, the research analyzes the radar waveform properties, sampling and data rates, the digital beamformer concept and requirements, and assesses their impacts on the radar performance.

Two transmit/receive (T/R) modules are built and a two-element array test bench is developed using the various National Instruments compact, reconfigurable, input-and-output (cRIO) and field-programmable-gate-array (FPGA) modules. The main software, written in LabVIEW, allows the test bench to demonstrate the proper functionalities of transmission and reception of the T/R modules. The hardware and software code could easily be extended for an eight-element array radar.

Lastly, a number of measurements to characterize the T/R module are conducted. No significant interference between the modulator and demodulator boards inside the compact T/R module chassis is observed.

**KEYWORDS:** TERMS Phased Array, Distributed Array Radar, Opportunistic Phased Array, Apherstructure, Radar, Digital Radar, Modulator, Demodulator, Transmit/Receive Module, Digital Beamforming, Array Demonstrator

## BI-SPECTRAL METHOD FOR RADAR TARGET RECOGNITION

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Target recognition and identification in battlefields has been a crucial determinant to the ultimate success or failure of modern military campaigns. Since World War II, the identification of friend or foe (IFF) systems installed in radar systems have served as the primary cooperative target identification techniques based on the “question and answer” interrogation loop of unidentified aircraft. However, the IFF system has a number of limitations that pose significant challenges in the positive identification of hostile and neutral aircraft, which can lead to a catastrophic outcome of fratricide and the possible elimination of a friendly or commercial aircraft.

To reduce the probability of fratricide and enhance the effectiveness and robustness of target identification, this research examines the radar non-cooperative target recognition (NCTR) technique of using the bi-spectral signatures of backscattered radar signals. The basic idea is that the geometry of the target scatterers and their mutual interactions impose features in the reflected radar signal that are typical and unique to the targets of interest. The bi-spectrum can be used to detect these multiple interactions features, which may then be used to match against a reference database that contains signatures of different target types for recognition and identification.

**KEYWORDS:** Bi-Spectrum, Non-Cooperative Target Recognition Techniques, NCTR Techniques, High Order Spectra Analysis, Backhoe Data Dome



# MASTER OF SCIENCE IN COMPUTER SCIENCE

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## A SECURE ALERT SYSTEM

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The integrated, mobile-alert system (IMAS) is a mobile-device messaging system that provides a means for people to stay connected and receive information in a modality that is constantly available to them. It was developed and built into a proof-of-concept (PoC) system at the Naval Postgraduate School from commercial, off-the-shelf products. Like other systems, this system suffers from vulnerabilities because of bugs. These bugs come from 1) COTS products, 2) design of the system, and 3) developed processes/applications. This study reviews the design of IMAS, its processes, and the COTS products. The focus of the study is to review these components and identify potential vulnerabilities. Furthermore, this research explains how these vulnerabilities may be exploited by probable threats and provides recommendations to correct or prevent vulnerabilities. Lastly, the thesis proposes other measures that would make the system more secure.

**KEYWORDS:** IMAS, Integrated Mobile Alert System, Identify Potential Vulnerabilities, Mobile Device Messaging System, Secure Alert System

## PERFORMANCE ANALYSIS OF AUTOMATED ATTACK-GRAPH- GENERATION SOFTWARE

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The current generation of network-vulnerability-detection software uses databases of known vulnerabilities and scans target networks for these weaknesses. The results can be voluminous and difficult to assess. Thus, the success of this technology has created a need for software to aid in network vulnerability analysis. Although research has shown the effectiveness of automated attack-graph-generation tools in displaying potential attack paths in a network, research involving the performance of these tools has been limited. Using empirical testing, authors collect quantitative data using CAULDRON, an attack-graph-generation tool developed at George Mason University, on a collection of simulated networks. By defining the model to include sets of nodes, which allow connectivity from all nodes to all nodes in the set; the number of nodes present in each set; the number of connections between sets; and the number of vulnerabilities per node as variables, researchers are able to observe the performance impact on CAULDRON of connectivity and the increased presence of vulnerabilities in the networks. The effect of these variables on processing time and memory usage is presented and can be used as a metric to assess the scalability of this tool within various customer environments.

**KEYWORDS:** Attack Graph, Network, Exploits, Vulnerability Analysis, Performance



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## COMPUTER SCIENCE

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### **DESIGN AND IMPLEMENTATION OF A PROTOTYPE ONTOLOGY AIDED KNOWLEDGE DISCOVERY ASSISTANT (OAKDA) APPLICATION**

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The World Wide Web has become a major source of easily accessible information for students, professionals, researchers, and the public. However, the volume of information available through the Web is so overwhelming that it is not unusual to get tens of thousands of “hits” when conducting a relatively simple search. Most existing search techniques use brute force based on keyword matches to find related Web pages. While the enormous speed of search engines improves the efficiency of such methods, effectiveness is not improved.

The objective of this thesis is to construct and test an ontology-based application to help users identify the most pertinent keywords for a search. By navigating ontologies that describe domains of interest, users are assisted in finding a relevant set of key terms that aid the search engines in narrowing, widening, or refocusing a Web search. Specifically, the thesis develops an ontology-aided, Web-search-assistant prototype to help users enhance the relevance and precision of the returned results through the use of a context provided by ontologies associated with each search.

**KEYWORDS:** Owl Aided Internet Search Knowledge Base Discovery Description Logics Ontology

### **A PERFORMANCE ANALYSIS OF AD-HOC OCEAN-SENSOR NETWORK**

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This thesis presents the simulation results and performance analysis of IEEE 802.15.4 in an oceanic environment. The 802.15.4 standard allows simple sensors and actuators to co-exist in a single wireless platform. The simulation is performed using Network Simulator, version 2 (NS2), which is an open-source tool. NS2 is an event-driven, network simulator developed at University of California Berkeley that simulates a variety of networks. Leveraging on the capabilities of NS2, the performance of the IEEE 802.15.4 protocol is studied, based on variations in node density, mobility, and loading conditions. The mobility model selected for the simulation considers the ocean effects on the mobile nodes, in particular the surface current. However, the available mobility models (random waypoint, Gauss-Markov, Manhattan grid, and reference point group) do not represent the real life mobility in an oceanic environment scenario. As a result, actual data of surface measurement in the Monterey Bay area is used to generate the node movements. Results from this analysis provide insights into the performance of IEEE 802.15.4 and its suitability for operating in an oceanic environment.

**KEYWORDS:** Ad-Hoc Networks, Wireless Networks, Mobile Networks, IEEE 802.15.4, Network Simulation, Performance Evaluation

## **ASSESSING THE EFFECTS OF HONEYPOTS ON CYBER-ATTACKERS**

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A honeypot is a non-production system designed to interact with cyber-attackers to collect intelligence on attack techniques and behaviors. While the security community is reaping the fruits of this collection tool, the hacker community is increasingly aware of this technology. In response, they have developed anti-honeypot technology to detect and avoid honeypots. While awaiting the discovery of newer intelligence collection tools, the relevancy of the honeypot must be maintained. Since the development of anti-honeypot technology indicates the deterrent effect of honeypot, this deterrent effect can be capitalized on to develop a fake honeypot. A fake honeypot is a real production system with the deterring characteristics of a honeypot, which induces the avoidance behavior of cyber-attackers. Fake honeypots will provide operators with workable production systems under obfuscation of a deterring honeypot when deployed in a hostile information environment. Deployed in the midst of real honeynets, it will confuse and delay cyber-attackers. To understand the effects of a honeypot on cyber-attackers in order to design a fake honeypot, a tightly secured, self-contained virtual honeypot is exposed to the Internet over a period of 28 days. It is concluded that the virtual honeypot is able to withstand the duration of exposure without compromise. The metrics pertaining to the size of the last packet suggest the departure of cyber-attackers during reconnaissance.

**KEYWORDS:** Fake Honeypot, Deception, Delay, Deterrence

## **PERFORMANCE ANALYSIS OF THE MOBILE IP PROTOCOL (RFC 3344 AND RELATED RFCS)**

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Mobile Internet protocol (IP) defines the mechanisms and protocol behaviors necessary to facilitate the seamless flow of traffic to a mobile host that roams from its normal home network. Of particular interest in this research is how this capability might support the relatively rapid roaming of a wirelessly connected host. This research focuses on isolating and analyzing the constituent components of the mobile IP protocol for the purpose of identifying any components that may be improved upon or exploited by an attacker intent on denying or delaying proper handoff service.

**KEYWORDS:** Mobility, Mobile IP, Mobile Node, Home Agent, Foreign Agent, Care-Of Address, Home Address, Home Network, Foreign Network, Handoff

## **SHORT-MESSAGE SERVICE SECURITY SOLUTION FOR MOBILE DEVICES**

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This thesis focuses on the security of short-message service (SMS) and the global system for mobile communication (GSM) network and the use of encryption to protect SMS messages. A detailed study of the GSM network, SMS protocol, and encryption schemes is conducted to understand the properties of different encryption schemes and their applicability to SMS messages. An experiment is conducted to

measure the actual performance of various encryption schemes on a modern smart phone device. An analysis of the encryption scheme properties and the performance measurement is then conducted to select a suitable scheme for SMS encryption. The selected scheme is implemented in the form of a secure SMS chat application to validate the viability of the selected encryption scheme. Potential applications of secure SMS in military settings are also discussed.

**KEYWORDS:** GSM Security, SMS Security, Mobile Device Security, Encryption, Mobile Device Performance Analysis, Secure Chat

### **A PERFORMANCE ANALYSIS OF BORDER-GATEWAY-PROTOCOL/MULTI-PROTOCOL-LABEL-SWITCHING, VIRTUAL-PRIVATE-NETWORK FAILOVER FUNCTIONALITY**

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Future military systems, many of which have unique timing requirements, will rely on the Global Information Grid (GIG) as the core data-communication infrastructure. The GIG currently uses the border gateway protocol (BGP)/multi-protocol label switching (MPLS), virtual-private-network (VPN) technology to provide secure and robust Internet protocol (IP)-level connectivity. This technology supports the provisioning of IP connectivity by a service provider to multiple customers over a common physical IP backbone, while allowing complete logical separation of customer traffic and routing information.

This research focuses on evaluating and validating the performance characteristic of BGP/MPLS VPN to determine if the use of this technology can provide the necessary performance guarantees required by military applications. A set of experiments has been performed to identify the key factors that affect the time delay of a network failure and recovery. Results show that reducing the ISIS SPF interval and Hello interval could shorten the failover latency while decreasing the ISIS SPF interval and TDP Hello interval could reduce the restoration delay, hence improving the BGP/MPLS VPN failover functionality.

**KEYWORDS:** Border Gateway Protocol, BGP, Multi-Protocol Label Switching, MPLS, Virtual Private Network, VPN, Failover Functionality

### **VALIDATING NETWORK-SECURITY POLICIES VIA STATIC ANALYSIS OF ROUTER ACL CONFIGURATION**

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The security of a network depends on how its design fulfills an organization's security policy. One aspect of security is reachability: whether two hosts can communicate. Network designers and operators face a very difficult problem in verifying the reachability of a network. This is due to the lack of automated tools and because calculations by hand are impractical given the sheer size of some networks.

The reachability of a network is influenced by packet filters, routing protocols, and packet transformations. A general framework for calculating the joint effect of these three factors was recently published. This thesis partially validates that framework through a detailed Java implementation, with the creation of an automated solution demonstrating that the effect of statically configured packet filters on the reachability upper bounds of a network can be computed efficiently. The automated solution performs its computations purely based on the data obtained from parsing router configuration files. Mapping all packet filter rules into a data structure called PacketSet, consisting of tuples of permitted ranges of packet header fields, is the key to easy manipulation of the data obtained from the router configuration files. This novel approach facilitates the validation of the security policies of very large networks, which was previously not possible, and paves the way for a complete automated solution for static analysis of network reachability.

**KEYWORDS:** Static Reachability, Network Analysis, Router Configuration, Network Security Policy



# **MASTER OF SCIENCE IN DEFENSE ANALYSIS**

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## **EAST-AFRICAN-CRISIS RESPONSE: SHAPING THE ETHIOPIAN PEACE FORCE FOR BETTER PARTICIPATION IN FUTURE PEACE OPERATIONS**

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Ethiopia, being one of the force-contributing countries to the East African Standby Brigade (EASBRIG), and given its resources, strategic location, and its military's long history, will have a significant role to play in creating a stable environment in the sub-region. This thesis analyzes the Organization of African Unity/African Union (OAU/AU) post-Cold War efforts to restore security and ensure stability in the region. The thesis also outlines the process of creating African Standby Forces (ASF) as sub-regional arrangements to bring stability and peace by preventing crisis or responding to crises whenever they arise in the region. To fulfill such missions, East African states have agreed to form EASBRIG, with each state contributing forces.

This thesis also analyzes Ethiopia's past and current participation in peace operations (from 1951 in Korea to ongoing missions in Liberia and Burundi) and argues that though Ethiopia's participation in peace operations is commendable, many things could be improved, and corrective measures need to be taken to better prepare for mission execution in regional and sub-regional crisis response efforts. There is work yet to be done on peacekeeping, and on peace enforcement in particular. A main goal of this thesis is to determine how to better organize the Peace Force and increase their efficiency and effectiveness for future peace operations.

**KEYWORDS:** OAU/AU, African Standby Forces, EASBRIG, Ethiopian Peacekeeping Practice, Peacekeeping Training, Peace Support Operations, Sub-Regional Peace Forces

## **AN EXAMINATION OF OVERT OFFENSIVE MILITARY OPERATIONS OUTSIDE OF COMBAT ZONES**

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Under the leadership of the United States Special Operations Command (USSOCOM), the military is undergoing transformation to more effectively counter the asymmetric threat of non-state terrorists and extremists in the "long war." After five years, however, one component of national security strategy is visibly unfulfilled: military pursuit of terrorists and extremists outside of Afghanistan and Iraq. The lack of offensive military efforts outside of areas designated as combat zones creates the impression that the long war has stalled. Overt offensive military operations targeting non-state actors may advance the counter-terrorism mission and serve as a deterrent.

This thesis identifies and analyzes four major constraints on the conduct of such operations: legal concerns about the use of force, use of the Central Intelligence Agency (CIA) for covert paramilitary activities, limits on USSOCOM and Special Operations Forces, and civilian and military leaders' aversion to risk. This thesis describes the historical, bureaucratic and cultural causes of the constraints, concluding with recommendations to allow the U.S. government and the U.S. military to pursue

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non-state terrorists and extremists with overt offensive military operations.

**KEYWORDS:** Terrorism, United States Special Operations Command, Covert Operations, Central Intelligence Agency, Special Forces, Special Operations Forces, International Law, Risk Aversion, Non-state actors, Title 10, Title 50

### **AN ANALYSIS OF COUNTERINSURGENCY IN IRAQ: MOSUL, RAMADI, AND SAMARRA FROM 2003-2005**

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After defeating the Iraqi military, Coalition forces spread out across Iraq to stabilize and transition control of the country back to Iraqis. This historical analysis of Mosul, Ramadi, and Samarra studies military operations intended to stabilize these three cities from April 2003 to September 2005. Prior to and after the reestablishment of Iraqi sovereignty, Coalition forces worked with Iraqi citizens at the local level to reestablish control of the population. In order to achieve this, the counterinsurgent force must understand that when consensus for non-violent political opposition does not exist within the governed populace, coercive measures must be taken to enforce local security. This analysis evaluates the effects of military operations over time and through frequent unit transitions with varying numbers of U.S. and Iraqi security forces. The conclusions gleaned from this analysis are summarized as unit approaches that either achieved control or failed to achieve control at the local level. This study suggests that a distributed light-to-medium equipped ground force operating within urban centers and in continuous close proximity to the population is best able to establish local control and partner with local police and military forces. This force should be enabled with language and cultural skills. Necessary combat multipliers include human intelligence collectors and social network analysts.

**KEYWORDS:** OIF, Insurgency, Counterinsurgency, COIN, Iraq, Samarra, Mosul, Ramadi, Control, Trust, Security, Population, Diamond Model, Control of the Population, Protection of the Population, Intelligence, Combat Outposts, HUMINT, Population Control, Consensus, Coercion, Expectation, Behavior, Influence, Networks

### **ETHNIC CONFLICTS AND GOVERNMENTAL CONFLICT MANAGEMENT**

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While some multiethnic states suffer from ethnicity-based conflicts, others enjoy the benefits of diversity, such as different skill sets, interests, and cultures. However, the cost of ethnic conflict is overwhelming. Ernest Regehr wrote in 1993 that almost two-thirds of political conflicts worldwide were ethnic conflicts. Although ethnic conflict is a worldwide phenomenon, it is not fate. Some ethnically divided nations have successfully lived together without giving rise to widespread bloodshed or forceful repression. Potential fault lines between parties have been reengineered and tensions have been regulated. In this study, the central question focuses on governmental policies as a tool to prevent conflict. Contrary to the general

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perception, the vast majority of ethnic conflicts are political. As a political problem, ethnic conflicts can be exacerbated or moderated by governmental policies or the lack of such policies.

This thesis includes three main parts. In the first part, Daniel Byman's four causes of ethnic conflicts are discussed. In the second part, a solution is recommended in the form of a coherent four-fold framework consisting of "population control," "winning hearts and minds," "strengthening national identity," and "reengineering the political system." In the last part, this framework is applied to present-day Iraq.

**KEYWORDS:** Ethnic Conflict, Ethnicity, Governmental Policies, Ethnic Conflict Prevention

### INTERNATIONAL CRISIS INFORMATION NETWORK

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This thesis illustrates that historically, there has been a separation between the U.S. military and outside agencies, including non-governmental organizations (NGOs) and international organizations (IOs). These communities often have misconceptions, biases, and stereotypical misperceptions of each other. Furthermore, these effects have sometimes degraded the ability of the military to accomplish its missions in stability, stabilization, transition, and reconstruction operations.

It is imperative that the military and outside agencies cooperate with each other. From this observation, the question is posed: How to develop a system to share information and lessons learned and collaborate on humanitarian activities within the international community? In answer to this question, the following hypothesis emerges: information sharing and collaboration on lessons learned can be accomplished through a web-based network.

The thesis studies the rift between the military, NGOs and IOs; shows their overlapping area of operations, the results of this separation, and the fact that these communities have a desire and a need to share information; discusses the definition of networks and explains how networks and communities of interest have developed; and advances a business model of how to best implement a web-based information sharing network.

This thesis includes the establishment of a prototype website to test the hypothesis.

**KEYWORDS:** Collaboration, Networks, Information Sharing, Humanitarian, Civil Affairs, NGO, Civil-Military Relations

### SYSTEMS APPROACH TO TERRORISM: COUNTERING TERRORIST TRAINING SUBSYSTEM

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This study on terrorism training follows the logic that terrorism is a "wicked problem" and there are various strategies to cope with it. Systems thinking is one such coping strategy for addressing "wicked problems." A system is a whole composed of complex organized elements (subsystems) interacting with each other and with their environment. The stability of a system depends on its components' alignment. Misaligning one of its components will destabilize or even disrupt the whole system. In this regard, the study defines terrorism and terrorist organizations in systems terms, explains their components and interrelations, and concludes that the most important component of a terrorist system is the training subsystem. Thus, it is important to understand how the subsystem functions in order to disrupt the whole system.



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The study reviews the types of terrorist training, how the terrorists and their organizations learn (process), what the terrorists learn (content), where the terrorists learn (location), and concludes that the internet is the new safe haven for terrorist training. It also demonstrates the adaptive capability of terrorist systems moving from land-based to internet-based training. Almost every terrorist organization on the U.S. State Department's designated terrorist organizations list exists on the Internet. One example is the Kurdistan Workers Party (PKK) terrorist network. The PKK's website network is analyzed by content and network structure using the social network analysis software UCINET. The goal is to develop strategies to eliminate the web presence of the terrorist training subsystem.

**KEYWORDS:** Terrorism, Terrorist Systems, Complex Adaptive Systems, Wicked Problems, Systems Approach, Terrorist Training, Terrorism on the Internet, PKK, Social Network Analysis

### **OPTIMIZING GROUND-BASED AIR DEFENSE IN SUPPORT OF HOMELAND DEFENSE:**

#### **THE CRUISE MISSILE THREAT**

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Since the attacks of September 11, 2001, involving commercial aircraft used as missiles to attack critical assets located within the United States, the U.S. has worked diligently to enhance its military air defense posture. Air defense of critical U.S. assets and National Special Security Events (NSSE) have been enhanced by adding static and proposed deployable Ground Based Air Defense (GBAD) systems designed to provide a "last line" of defense from air attacks over U.S. soil. Currently, this last line of defense is incorporated with the air and maritime military air defense forces, providing a "defense in depth" over critical assets, but it does not support the air and maritime air defense over broader ranges of U.S. soil where critical assets do not exist. As the U.S. continues to enhance its air defense posture around critical assets and high priority events against terrorist attacks from the air, it is reasonable to assume that the terrorists may adjust their strategy for air attacks. The terrorists may deem it more beneficial to attack targets that lack a last line defense. It is therefore critical to examine new means and methods to provide GBAD in areas that may be determined to be less lucrative targets. In addition to the proposed alternate terrorist strategy, it is also reasonable to assume that increased security measures in the Transportation Security Administration (TSA) will deter the terrorists from attempting another hijacking event; thus forcing them to seek other means of attack. Cruise missiles (CM) are a cheap and effective means of causing limited destruction. Cruise missiles can be programmed to maneuver and operate at various altitudes and are small enough to be transported with little to no visibility. A cruise missile in the wrong hands could find its way to within miles of the U.S. borders and coastlines. If launched, a cruise missile could engage random targets throughout the U.S., such as malls or schools, and cause a major upset to national security. Therefore, a defense system should be established that incorporates GBAD and is capable of engaging the CM threat over the entire U.S. border and coastal regions with little to no notice.

**KEYWORDS:** Homeland Defense, Cruise Missile Defense, Air Defense, Low Cost Interceptor, Joint Air Defense Operations Center

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### **SOMALIA: INTERGOVERNMENTAL AUTHORITY FOR DEVELOPMENT'S ATTEMPT TO RESTORE SOMALIA'S TRANSITIONAL FEDERAL GOVERNMENT**

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Political solutions have been found for several longstanding conflicts in Africa in 2003 - in the Democratic Republic of the Congo, Liberia, and Burundi. The political arrangements in these countries may not necessarily usher in permanent peace and stability, but they at least afford an opportunity to work toward such goals. Unfortunately, this is not the case for Somalia, where anarchy, violence, and chaos have prevailed for over 15 years. A national reconciliation conference-the fourteenth of its kind-sat in Nairobi for two years and finally formed a Transitional Federal Government (TFG) in August 2004. As usual, the outcome of the conference was not welcomed, either by warlords or later by Islamic clerics in Somalia. Nonetheless, despite institutional obstacles, the Intergovernmental Authority for Development (IGAD) has continued to press their intention to send peacekeepers to Somalia to reinstall the fragile transitional government against the wishes of the Islamic Courts Council (ICC). This thesis examines the possible strategies that IGAD should consider using in its intended mission of supporting the restoration of the Transitional Federal Government.

**KEYWORDS:** Intergovernmental Authority for Development, National Reconciliation, IGAD Force in Somalia, IGASOM, Peace and Stability, Transitional Federal Government, Establishing Popular Support, Factional Clan Conflicts, Islamic Court Council, Islamic Fundamentalism, Sharia Law, Irredentist Somali Policy

### **“HACER O NO HACER” (TO DO OR NOT TO DO): MEXICAN FOREIGN POLICY AND UNITED NATIONS PEACEKEEPING OPERATIONS IN THE 21ST CENTURY**

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The arrival of President Fox brought important changes in the way of governing. With a moral obligation to be different, one of the main goals of President Fox's administration, since the beginning, was to pursue a more dynamic participation by Mexico in the political issues of the world. This was to be accomplished by taking up several measures, including enhancing economic trade with the United States and other nations, world summits in Mexico, improvement of human rights, and others. Among those plans, one attracted special attention when Mexico asked for a seat as a non-permanent member in the UN Security Council for the period 2002-2003, the third time in Mexican history. There were divided opinions on the subject because Mexico would be directly involved in UN decisions concerning internal situations of other countries, something that goes against the foreign policy principles of Mexico. Eventually this discussion opened doors for other topics, including the possibility of Mexico participating actively in peacekeeping operations by sending troops overseas; this initiated a bitter debate in the political sphere.

This study analyzes Mexican foreign policy and the historical perspective of the foreign principles stated in the Mexican Constitution's Article 89, followed by a discussion of their influence and interpretation in the political-military environment before and during the administration of President Fox. The study includes an analysis of the new social and political scenario that Mexico is facing in order to determine the odds and obstacles when dealing with military participation overseas. As Mexico takes its place in the community of nations, the country's leadership needs to search for possible options and test whether the new Mexican political apparatus has the flexibility to address current threats and requirements for international security. An analysis of the capabilities of the Mexican armed forces is also necessary in order to determine their capacity to execute multinational operations. Finally, the real benefits and/or risks of getting Mexico involved in these kinds of operations are identified.

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**KEYWORDS:** Peacekeeping Operations, Mexican Foreign Policy Principles, Partido Revolucionario Institucional, Estrada Doctrine, Non-Intervention and Self-Determination

### **TERRORISM BASE POTENTIAL IN THE TRI-BORDER AREA OF LATIN AMERICA**

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This study of the Tri-Border Area of Latin America demonstrates that the region is highly vulnerable to the penetration and development of illegal interests, and thus it is also vulnerable to terrorism. The Tri-Border Area is bounded by Puerto Iguazu, Argentina; Ciudad del Este, Paraguay; and Foz do Iguazu, Brazil. It has always been considered fertile ground for terrorists groups. Illicit activities are common, generating billions of dollars annually in money laundering, arms and drug trafficking, money and document forgery, and electronic media counterfeiting. This area offer terrorists potential financial sources, access to illegal arms and advanced technology, ease of movement and concealment, and a population in which to recruit new members. While the Tri-Border Area is not a major center of gravity in the Global War on Terrorism, compared to other centers of terrorist operations like the Near East or Europe, it has an important position in the strategy to combat international terrorism.

**KEYWORDS:** Counterterrorism, Tri-Border, Transnational Crime, Drug Traffic

### **BULGARIAN NATIONAL SECURITY AND SPECIAL OPERATIONS**

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This study explores the nature of Bulgarian national security and how it is supported by Bulgarian Special Operations Forces (BSOF). It examines the changing global security environment and its implications on Bulgarian security challenges in the 21st century. In particular, the Global War on Terror and the newly acquired NATO membership have posed new challenges for the Bulgarian Armed Forces, including BSOF. This thesis explores Bulgarian security strategy and NATO requirements for special operations, and analyzes how each of these may be satisfied, in part, by BSOF. The shortfalls between Bulgarian and NATO needs and BSOF's current capabilities suggest that BSOF should be unified under a single joint Special Operations Command directly subordinated to the highest commanding headquarters of the Bulgarian Armed Forces. Moreover, BSOF should be provided with an independent funding program with dedicated air and maritime assets for strategic support, and with advanced SOF--specific equipment.

This study suggests the necessity for reorganization and improvement of BSOF in response to the requirements of national security and NATO Special Operations requirements. It posits that a restructuring and enhancement of BSOF is likely to strengthen Bulgarian national security, and help improve the global security environment.

**KEYWORDS:** Bulgaria, Bulgarian National Security, Special Operations, Bulgarian Special Operations Forces, BSOF, Security Threats, Bulgarian National Security Strategy, Bulgarian Military Strategy, NATO, War on Terror, Terrorism, U.S. Special Operations Forces, Military Capabilities, Command and Control, Unified Command

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## DEFENSE ANALYSIS

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### HOW THE U.S. SQUANDERED ITS CREDIBILITY AND HURTS ITS MISSIONS

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

**Advisor: Dorothy Denning, Department of Defense Analysis**

**Second Reader: Anna Simons, Department of Defense Analysis**

Trust plays a vital role in all aspects of life, affecting whether goals are met and the cost of achieving them. It affects and is affected by culture, expectations, and behavior. This thesis examines the nature of trust and its role in military operations and winning "hearts and minds." This thesis also examines American foreign policy and its relation to trust. Iraq is used as a case study to examine the interaction of U.S. foreign policy and operations with trust and culture. The thesis shows how U.S. policy and actions have undermined trust in the U.S.

**KEYWORDS:** U.S. Credibility, Causes of U.S. Failures in Various Missions, Trust and Its Importance to Mission Success

### ADAPTING THE VEHICLE-MOUNTED, TACTICAL LOUDSPEAKER SYSTEM TO TODAY'S OPERATIONAL ENVIRONMENT

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From the time they were first used by the United States Army during World War II, loudspeakers have proven to be an effective means for tactical psychological operations (PSYOP) teams to disseminate messages to their intended target audiences. The vehicle mounted family of loudspeakers (FOL) is the loudspeaker system currently being utilized by tactical psychological operations forces as the primary mobile means of disseminating messages or sound effects to their target audiences. In its current configuration, the vehicle mounted loudspeaker system is not meeting the needs of the tactical PSYOP teams (TPTs) conducting operations in today's operational environment. The objective of this project is to determine why the current loudspeaker system is not meeting the requirements of the TPTs and to provide recommended changes to the current FOL system.

**KEYWORDS:** PSYOP Tactical Loudspeaker

### THE DEPARTMENT OF DEFENSE'S USE OF IRAQI EXILES

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

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

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The U.S. government has utilized exiles for decades, the latest example being the use of Iraqi exiles starting after the Gulf War. For close to thirteen years, America supported opposition groups, overtly after the signing of the Iraq Liberation Act of 1998. The Department of Defense's role until months before the invasion of Iraq was minimal, but then increased dramatically. Iraqi opposition groups provided names of volunteers willing to work with the U.S. military. Most were turned away for a number of reasons, but those selected were trained in civil affairs operations and embedded with great success in small teams into U.S. civil affairs units.

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Another program, even more ad hoc, involved Ahmad Chalabi's fighting forces. Not receiving the welcome from Iraqis that intelligence experts told them to expect, U.S. military commanders were eager to put an "Iraqi face" on operations and build the core of the new Iraqi army. Chalabi's fighters, escorted by U.S. Army Special Forces A-Teams, provided a number of useful services to the war effort, but with minimal logistical support and hindered by Chalabi's political ambitions, they were quickly disbanded.

Exiles have many of the skills necessary in conventional and asymmetric warfare: language skills, familial ties, and cultural proficiency. But this unique segment of society needs to be better utilized by the DoD. After analyzing each of the Iraqi exile programs in detail, suggestions on how to harness needed skills in the future are offered.

**KEYWORDS:** Ahmad Chalabi, Army Special Forces, Civil Affairs, Counterinsurgency, Diaspora, Exiles, Free Iraqi Forces, FIF, Free Iraqi Fighting Force, FIFF, Iraq Liberation Act of 1998, Iraqi Opposition Groups, Operation Iraqi Freedom

### **UNMANNED, AERIAL VEHICLE USE IN ARMY BRIGADE COMBAT TEAMS: INCREASING EFFECTIVENESS ACROSS THE SPECTRUM OF CONFLICT**

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

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**Second Reader: Eugene P. Paulo, Department of Systems Engineering**

One of the major strengths of the U.S. Army conventional force and its doctrinal methods is the ability to conduct operational and tactical maneuver out of contact with an enemy force. This allows the U.S. to decide the time, place, and conditions of contact. Under this system, national, strategic, and operational intelligence systems generate, analyze, and disseminate intelligence to maneuver units. When major conventional operations conclude, or in operations where they never take place, conventional forces transition to stability and support operations (SASO). Conducting SASO operations generally requires extensive interaction with, and conducting operations among, a local population. The necessary physical interaction with a populace causes two significant problems for conventional forces: traditional intelligence assets (national, strategic, operational) are largely irrelevant to the operations that U.S. forces conduct, and interacting with a local population whenever outside of a forward operations base affects the actions of the population. In military operations other than conventional combat, intelligence must be generated from the lowest possible tactical level, something conventional forces are not organized or equipped to do. Proliferating shadow tactical unmanned aerial vehicle (TUAV) platoons throughout Army brigade combat team's (BCTs) subordinate battalions will enable commanders to gather the tactical intelligence necessary for success.

**KEYWORDS:** Unmanned Aerial Vehicle, Unmanned Aerial System, Brigade Combat Team

### **THE EFFECTS-BASED APPROACH TO OPERATIONS AND THE FUTURE OF ARMY DOCTRINE**

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

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

This thesis addresses the implications of the Joint effects-based approach to operations (EBAO) concept on U.S. Army doctrine. Joint EBAO has the potential to radically change the joint concept of warfare if one considers Joint EBAO as a more holistic approach to planning and conducting operations. Despite the Army's resistance to apply Joint EBAO below the Corps level, numerous case studies from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) exist to prove otherwise and demonstrate how Joint EBAO can be integrated into Army doctrine. This thesis begins by reviewing the evolution of Joint EBAO from its inception during Desert Storm, through Millennium Challenge 2002 (MC02), to its present

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form. Next, it compares Army doctrine to the current Joint EBAO concept and identifies potential shortfalls and conflicts between the two. By addressing the major shortfalls or conflicts, this thesis answers the question of whether or not Joint EBAO has a role in future Army doctrine. Finally, recommendations are made in the form of doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) as to how EBAO should be implemented into Army doctrine. An analysis of the implications of this application to the Army organization is included.

**KEYWORDS:** Effects-Based Operations, Effects-Based Approach to Operations, Effects-Based Thinking, Future Army Doctrine, Army Operational Concept, System of System Analysis, Effects, Joint Doctrine

### **U.S. MILITARY GROUP (USMILGP) COLOMBIA: TRANSFORMING SECURITY COOPERATION IN THE GLOBAL WAR ON TERRORISM**

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The key to long-term success in the global war on terrorism involves maximizing the effectiveness of U.S. military aid to partner nations. The United States cannot sustain long-duration deployments of thousands of troops. However, international crisis will not likely subside. The United States needs to encourage and better prepare its partner nations to take more active roles. As exemplified in Colombia, Security Assistance Organizations (SAO) must build and increase the capabilities of partner nations' militaries and be prepared to rapidly expand to support a partner nation's counter-insurgent/terrorist/narco-terrorist effort. Current worldwide SAO structures do not adequately support such robust ventures.

The government of Colombia has been fighting insurgents, international crime, and terrorism for the past five decades. Plan Colombia and post-911 expanded authorities have allowed the United States to provide substantial and increasing support to assist Colombia. U.S. support to the Republic of Colombia may be considered a model for limited joint support to a partner nation's counterterrorism/counter-narco-terrorism fight. The current Military Group (MILGP)-Colombia restructuring plan provides a base model from which a flexible model for a more robust and responsive SAO: a Joint Security Assistance and Cooperation Command (JSACC). JSACCs will allow the United States to succeed in supporting a partner nation in an environment that is neither war nor peace.

**KEYWORDS:** AUC, Colombia, El Salvador, Expanded Authority, ELN, FARC, FMF, FMS, Foreign Internal Defense, High Value Targets, IMET, MILGP, Narco-Terrorism, NAS, PATT, Plan Colombia, Security Assistance, Security Assistance Organizations, Security Cooperation, SOUTHCOM, Supported/Supporting Command Relationship, Theater Security Cooperation Plan, USARSO, WIAS

### **THE PERFECT STURM: INNOVATION AND THE ORIGINS OF BLITZKRIEG IN WORLD WAR I**

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**Second Reader: Robert L. O'Connell, Department of Defense Analysis**

What are the origins of tactical innovation in large, bureaucratic, military systems? This study provides a detailed analysis of how the German Army in World War One took advantage of innovative tactical methods developed by their junior and non-commissioned officers in the field. While many historians often look at the results of WWI from the perspective of the general officers and politicians (i.e., top-down), they often overlook the important roles played by creative junior officers in revolutionizing the manner in which the German army fought. These innovations, when supported by senior leadership, led to massive

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operational and strategic gains for the German army late in World War One. The author explores how the German army successfully applied these tactical innovations at the Twelfth Battle of the Isonzo, a.k.a., the Battle of Caporetto, in 1917. The result was a crushing Italian defeat. This success encouraged the German leadership to attempt similar offensives in 1918 on the Western Front in France. Initially successful, the offensives later stalled. However, the lessons of these attacks formed the basis for what would become universally known as blitzkrieg, or “lighting-war” tactics. These lessons continue to effect how modern militaries employ combined arms in maneuver warfare today. This case study highlights the importance of “bottom-up” tactical innovation within today’s U.S. military.

**KEYWORDS:** World War I, Innovation, Transformation, Military Innovation, Organizational Innovation, Technological Innovation, Military History

### **HONDURAS’ NATIONAL SECURITY STRATEGY TO COMBAT TERRORISM**

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

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After the September 11 attacks, Honduras committed to support the global war on terrorism (GWOT), but priorities in national objectives other than terrorism have kept the Honduran government from developing a strategy and the necessary counter-terrorism infrastructure to combat this emerging threat. This research examines current threats in Latin America, in Honduras in particular. It also suggests a developmental strategy to enhance the country’s capabilities to combat terrorism by the employment of instruments of national power in a multidimensional way, capable of preventing, deterring, and responding to terrorist acts. This study uses a brief analysis based on the concepts of suitability, feasibility, and acceptability in order to identify the risk that the proposed strategy could incur. The study concludes by proposing a series of recommendations that should minimize risk and make this strategy feasible for supporting the GWOT.

**KEYWORDS:** Terrorism in Latin America, Counterterrorism Organizations, Drug Trafficking and Terrorism, Strategy

### **ORGANIZED CRIME IN THE UNITED STATES: ORGANIZATIONAL ANALOGIES FOR COUNTERINSURGENCY STRATEGY**

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

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**Second Reader: Anna Simons, Department of Defense Analysis**

As modern warfare moves towards the lower end of the intensity spectrum, conventional forces are placed in unconventional roles outside their traditional high intensity military specialty. By showing that there are analogies between organized crime and insurgencies, further studies can be conducted on the applicability of modern law enforcement tactics to military operations. This thesis shows that there are organizational and conceptual analogies between organized crime families and insurgencies. They both organize themselves as secret societies with similar hierarchical command structures for both survival and operational needs. Both organized crime families and insurgencies must remain hidden from authorities, whether from law enforcement agencies, such as the FBI, or the military. The similarity between organized crime and insurgent organizations provides a broad basis for further study in other areas. The FBI and other law enforcement agencies have been combating organized crime families for decades, and have used proven techniques of infiltration, informants, wiretaps, and electronic eavesdropping to expose organized crime’s largely invisible network. Based on the similarities between organized crime families and insurgent organizations, law enforcement tactics and their applicability to modern counterinsurgency doctrine are an area for further study.

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**KEYWORDS:** Organized Crime, La Cosa Nostra, Mafia, ALN, Battle of Algiers, Hierarchal Command Structure

### RELIGIOUS DESECRATION AND ETHNIC VIOLENCE

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

Desecration of religious places has drawn the attention of the world media, academics, and policymakers on a number of occasions. The desecration of the Church of the Nativity, the cross-desecration by both Orthodox and Muslims of the Balkans, the desecration of the Sikh Golden Temple, the destruction of the Bamiyan Buddha Monolith by the Taliban in Afghanistan, and many others have attracted world condemnation. However, there has been little or no cross-sectional research or academic enquiry into the causes or impacts of desecration. The question of what constitutes desecration and what are the impacts of desecration are the subject of this study.

This study attempts to establish that desecration could be a factor for protest, rebellion, and violence, often independent of political, economic, and social factors. The study begins with a discussion about the concept of the sacred and profane, followed by an analysis of what factors influence sacredness. Based on a historical perspective of desecration and pollution, a causal relationship is established to explain why believers consider desecration to be a challenge and resort to protests, rebellion, or violence. Finally, the hypotheses are demonstrated qualitatively, through a number of cases studies.

**KEYWORDS:** Religion, Sacredness, Desecration, Pollution, Ethnic Violence, and Religious Terrorism

### THE MILITARY COOPERATION GROUP

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The United States has experienced significant difficulty of late with two factors: a) the question of how to fight against a networked enemy, and b) the need for more cultural intelligence. This thesis describes a structure to assist with both those needs. The premise is that an expanded and improved network of U.S. military groups is the weapon of choice for the war on terrorism and beyond. The purpose of this thesis is to propose a policy that will consolidate the functions of defense attachés, security assistance officers, and a proposed corps of ethnographic information officers into a network of embassy annexes that will cover every nation in which the United States has a country team. The intertwined questions of how to fight a network and how to gather cultural intelligence present the United States with a strategic challenge, and require the examination of the type of information the Department of Defense captures, and what is to be done with that information. This thesis proposes a means to collect ethnographic information and a structure for using that information to make effective decisions in a variety of traditional security roles, including the fight against transnational terror networks.

**KEYWORDS:** Ethnographic Information, Cultural Awareness, Cultural Intelligence, Network



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## FOR GOD OR COUNTRY? RELIGIOUS TENSIONS WITHIN THE UNITED STATES MILITARY

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

Today we live in a world of heightened religious awareness and sensitivity. The events of September 11, 2001, sent a shock wave throughout American society and in some cases ignited a religious spark in those shocked by the attacks. The result has been a distinct and clearly visible fragmentation of the United States along religious and ideological boundaries. The United States military is not immune to stress caused by these divides. There have been claims of anti-Muslim sentiment within select units of the U.S. Army, accusations that some leaders at the U.S. Air Force Academy were using their positions to promote their faith and discriminate against minority faiths, and allegations that the U.S. Navy is prohibiting chaplains from practicing their faith. These and other cases are examined in this thesis, along with religious diversity trends since 2001, to demonstrate that the potential for continued and increased religious conflict in the military is high. It is further argued that the solution to avoiding these conflicts is through training and education provided at the initial stages of enlisted training and at the commissioning source for officers.

**KEYWORDS:** U.S. Constitution, Bill of Rights, First Amendment, Freedom of Religion, Founding Fathers, God, Jesus, Christian, Christians, Christianity, Religion, Religious Accommodation, Religious Intolerance, U.S. Military, Chaplain, Chaplaincy, Wicca, Wiccan, Islam, Muslim, Sexual Orientation, Abortion, Stem Cell Research, Media, Conservative, Liberal, Secular

## AMERICANS' VIEWS OF THE MUSLIM WORLD: REALITIES AND FALLACIES

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

The 9/11 terror attacks prompted a large number of public opinion surveys in the Islamic world by Gallup, Pew, Zogby, and others seeking to understand the level and nature of Muslim antagonism toward America. Far less attention has been paid to public opinion surveys of Americans concerning their views of Islam, Muslims, and Muslim countries. This thesis sorts through the surveys and presents some surprising findings. First, while American views of Muslims have generally been rather unfavorable, the events of 9/11 did not have a marked change on those views. Moreover, Americans tend to make distinctions between Muslims as individuals, toward whom they have a relatively favorable view; Muslim countries, toward which they have a varied view; and Islam as a religion, toward which they have the most negative view. In addition, the polls show that misunderstandings about Islam and Muslims are pervasive among Americans.

This thesis argues that the American Muslim community must play a leading role in correcting such misperceptions. In the absence of a sustained effort, there is little in the survey data that would lead one to believe that a change in perception is imminent.

**KEYWORDS:** Americans' Views of the Islamic World, Americans' Views of the Muslim World, Role of American-Muslims, Americans' Views of Muslim Countries, Americans' Views of Middle Eastern Muslims, Islam and U.S., Islam in U.S.

# **MASTER OF SCIENCE IN ELECTRICAL ENGINEERING**

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## **NEURAL NETWORK DESIGN ON THE SRC-6 RECONFIGURABLE COMPUTER**

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

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**Second Reader: Jon T. Butler, Department of Electrical and Computer Engineering**

This thesis presents an approach to image classification via a Multi-Layer Perceptron (MLP) Artificial Neural Network (ANN) on the SRC-6 reconfigurable computer for use in classifying Low Probability of Intercept (LPI) radar emitters. The rationale behind the previously unexplored use of new reconfigurable computers combined with neural networks for this application is the potential for near real-time classification. Current potential near-peer competitors have access to LPI technology, so development of quick classification methods is crucial for ships to determine intent and to enable the possibility for self-defense against these types of emitters. The neural network, based on work conducted by Professor Phillip E. Pace of the Naval Postgraduate School (NPS), generates integer-cast weights by first using a sequential processor to conduct floating-point back-propagation to train the network on potential time-frequency images that allows generation of weights with lower overall Root Mean Squared (RMS) errors. The weights are then used in a parallel-processing reconfigurable computer for close to real-time classification. A second method of direct pixel comparison using Exclusive-Or (XOR) logic is presented as an alternative image classification method. Comparisons to similar representations in C++ are provided, for use in judging comparative error levels and timing between parallel and sequential processing methods.

**KEYWORDS:** Image Classification, Neural Network, SRC-6, Reconfigurable Computer, Backpropagation, LPI Emitter

## **IMPLEMENTATION OF CONFIGURABLE FAULT TOLERANT PROCESSOR (CFTP) EXPERIMENTS**

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

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**Second Reader: Alan A. Ross, Navy Tactical Exploitation of National Capabilities (TENCAP) Chair  
Professor**

The configurable, fault-tolerant processor (CFTP) team at the Naval Postgraduate School was created to develop, test, and implement reliable computing solutions for the space environment. The CFTP team seeks to design reliable circuits using field-programmable gate arrays (FPGA), including designs that mitigate the radiation hazards posed to FPGAs. A significant challenge faced by the CFTP team has been the integration and subsequent software development of the CFTP architecture, which includes a “controller” and an “experiment” FPGA.

This thesis investigates some of the specific design issues that must be considered for future experiments, including timing between the two FPGAs and data throughput of the CFTP architecture. Procedures for the development and implementation of experiments are detailed for the benefit of future experimenters who may be new to designing for FPGAs. Lastly, the controller program is streamlined such that only minor modifications are required by prospective users in order to conform to specific experiments.

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Over the years, the CFTP team has produced ample experiments that will provide reliable computing solutions for the space environment. Now, in addition to the “what” is to be used in space, this thesis presents “how” to run them in space.

**KEYWORDS:** Configurable Fault Tolerant Processor, Field Programmable Gate Array, Experiment, Controller

## **TRAFFIC PROFILING OF WIRELESS SENSOR NETWORKS**

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**Second Reader: Murali Tummala, Department of Electrical and Computer Engineering**

Network security is vital in the wireless networks that are widely used today. Wireless networks that maintain a high degree of confidentiality, integrity, and availability are desired. Wireless sensor networks pose unique challenges and limitations to the traditional schemes, which are used in the other wireless networks for security protection, and are due mainly to the increased vulnerability of physical attacks, energy, and communication limitations. This thesis introduces the foundations of a network and anomaly-based Intrusion Detection System (IDS) tool, including both hardware and software components, that can be used for traffic profiling and monitoring of a wireless sensor network. The work demonstrates how the IDS should capture and store traffic and use this information to create traffic profiles and baselines for normal traffic behavior. The thesis then describes how these baselines can be used to generate alerts based on traffic variations that imply possible attacks. Profiles on typical implementations of wireless-sensor networks are observed and analyzed. Finally, initial indications from basic analysis of wireless-sensor network traffic demonstrates a high degree of self-similarity.

**KEYWORDS:** Wireless Sensor Networks, Intrusion Detection System, IDS, Self Similarity, Packet Sniffer

## **SOFTWARE DEFINED RADIO DESIGN FOR AN IEEE 802.11A TRANSCEIVER USING OPEN SOURCE SOFTWARE COMMUNICATIONS ARCHITECTURE IMPLEMENTATION EMBEDDED (OSSIE)**

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**Second Reader: R. Clark Robertson, Department of Electrical and Computer Engineering**

In this thesis, the design of a software defined radio (SDR) transceiver using Open Source Software Communications Architecture (SCA) Implementation Embedded (OSSIE) as the software platform is presented. Designing an SDR requires both an appreciation of the IEEE 802.11a (wireless Local Area Network at 5 GHz band) protocol standard, and an understanding of the C++ and CORBA software tools available to implement the physical transmitter and receiver layers. For this work, the Incremental Development Model is chosen. This model is comprised of three stages: Design, Develop, and Verify. The advantage of this model is its incremental nature, which allows the developer to learn from earlier versions of the system. Implementing the IEEE 802.11a physical layer using OSSIE requires a total of 23 components, 12 different functionalities, and 31 sequential input-output (I/O) processes for the transmitter, while the receiver is implemented with 18 components, 12 different functionalities, and 20 sequential I/O processes. The completed transmitter and receiver layers are validated successfully according to test cases stipulated in the IEEE standard.

**KEYWORDS:** Software Defined Radio, IEEE 802.11a, Wireless Local Area Network, Open Source SCA Implementation Embedded, OSSIE, C++, CORBA

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## **SIMULATION AND PERFORMANCE ANALYSIS OF ROUTING IN SONET/SDH DATA COMMUNICATIONS NETWORK (DCN)**

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**Second Reader: Randy L. Borchardt, Department of Electrical and Computer Engineering**

This thesis analyzes the ITU-T G.7712 standard to evaluate the main features and specifications that are defined in the 11/2001 edition. The latest 03/2003 revision is also reviewed to determine the changes and latest updates presented in that paper. In order to determine compliance among telecommunication industry vendors, surveys are also conducted to identify the most widely supported standard. Finally, simulations are run using Opnet IT Guru software for the two routing protocols defined in the standard, IS-IS and OSPF, to examine their characteristics and determine their usefulness. It is observed that OSPF achieves better performance and is the least obtrusive on network operations.

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

## **SOFTWARE COMMUNICATIONS ARCHITECTURE (SCA) COMPLIANT SOFTWARE DEFINED RADIO DESIGN FOR IEEE 802.16 WIRELESSMAN-OFDM TM TRANSCEIVER**

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**Second Reader: R. Clark Robertson, Department of Electrical and Computer Engineering**

Demands for seamless mobile communications are driving the research and development of software defined radio (SDR), which enables a single terminal to transmit and receive in distinct wireless systems through a simple change in software to reconfigure the terminal's functions. Its application areas include military use, home networks, intelligent transport systems, and cellular communications. Several SDR software architectures have been developed during the last few years. One implementation of the Software Communications Architecture is the Open Source SCA Implementation Embedded (OSSIE), which was developed by the Mobile and Portable Radio Research Group (MPRG) at Virginia Tech. The goal of this thesis is to design and implement transmitter and receiver components using OSSIE. The components are designed for use in the IEEE 802.16 WirelessMAN-OFDM TM transceiver and for contribution to the library of components developed. Thus the components are flexible and useful for other transceivers by specifying the appropriate parameters.

**KEYWORDS:** Software Defined Radio, Software Communications Architecture, OSSIE, IEEE 802.16

## **IMPLEMENTATION OF A FAULT TOLERANT CONTROL UNIT WITHIN A FIELD PROGRAMMABLE GATE ARRAY (FPGA) FOR SPACE APPLICATIONS**

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**Second Reader: Alan A. Ross, Navy Tactical Exploitation of National Capabilities (TENCAP) Chair Professor**

The space environment presents a challenge for the development and utilization of electronics. Field Programmable Gate Arrays (FPGAs) represent a possible solution to that challenge. An FPGA itself is not a Fault Tolerant component, but with the correct configuration it can emulate and behave as one. The Configurable Fault Tolerant Processor (CFTP) developed at the Naval Postgraduate School (NPS) is intended to work as a platform for the implementation and verification of designs and experiments for

space applications. The major components of the CFTP are two FPGAs, one configured as the experiment FPGA and the other as the control FPGA. The configuration of the experiment FPGA already includes fault tolerant properties against radiation and its effects on FPGAs. The control FPGA did not have any fault tolerance built-in.

This thesis investigates the design, considerations, implementation, performance, and resource utilization of a Fault Tolerant Control Unit based on FPGA technology using a Triple Modular Redundancy (TMR) approach.

**KEYWORDS:** Field Programmable Gate Array, FPGA, Fault Tolerant Control Unit, FTX1, Triple Modular Redundancy, TMR, Resource Utilization, Single Event Upset, SEU, Optimization, Manual Injection of Errors

### **VIBRATION ANALYSIS USING A MEMS ACCELEROMETER**

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

**Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering**

**Second Reader: Roberto Cristi, Department of Electrical and Computer Engineering**

The primary objective of this thesis is to study the feasibility of using a micro-electro-mechanical system (MEMS) accelerometer to monitor vibration signatures of a machine to determine if the machine is operating properly. The secondary objective is to investigate the self test features of the accelerometer used in the vibration monitoring.

An Efecter "Octavis" accelerometer sensor is used in this study. It is used to monitor a small air pump and an air conditioning (AC) system. The sensor provides the amplitude for the frequency spectrum of the motor vibration. A reference signal is calculated by taking an average of the spectrum over 30 seconds. Two methods (a ratio of cross-correlation coefficients and a spectral distance) are used to compare the reference to the sensor data. The spectral distance method proves to be the better of the two. Using this method, the system can sense when the pump or the AC unit are malfunctioning. The self-test feature involves exciting the built-in self-test (BIST) pin of the accelerometer with a signal generator. Then the impulse response of the accelerometer is measured from the output pin using an oscilloscope.

**KEYWORDS:** MEMS, Vibration, Accelerometer

### **PERFORMANCE ANALYSIS OF IEEE 802.11G RECEIVERS WITH ERASURE DECODING TO MITIGATE THE EFFECTS OF PULSE-NOISE INTERFERENCE**

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

**Master of Science in Applied Physics-December 2006**

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**Richard Harkins, Department of Physics**

This thesis examines the performance of IEEE 802.11g wireless local area network (WLAN) standard receivers when the signal is transmitted over a frequency-selective, slowly fading Nakagami channel in a pulse-noise interference environment when errors-and-erasures Viterbi decoding is used. The different combinations of modulation (both binary and non-binary) and convolutional code rate specified by the WLAN standard are examined. The performance obtained with errors-and-erasures decoding (EED) is compared with the performance obtained with errors-only hard decision Viterbi decoding (HDD), as well as that obtained with soft decision Viterbi decoding (SDD) for binary modulation, while for non-binary modulation, EED performance is compared with HDD performance. It is found that EED can significantly improve performance under some conditions when pulse-noise interference is present.

**KEYWORDS:** IEEE 802.11g WLAN Standard, Nakagami Fading Channel, Hard Decision Decoding, Errors-and-Erasures Decoding, Soft Decision Decoding, Pulse-Noise Interference

# **MASTER OF SCIENCE IN ENGINEERING SCIENCE**

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## **DEVELOPMENT OF AN ARTILLERY ACCURACY MODEL**

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This thesis explains the methodologies that predict the trajectory and accuracy of an unguided, indirect-fire launched projectile in predicted fire. The trajectory is the path that a projectile travels to the impact point, while the accuracy is the measurement of the deviation of the impact point from the target. In addition, this thesis describes the methodology for calculating the various factors, such as drag and drift in the trajectory calculation. A three degree-of-freedom model is compared to a five degree-of-freedom model. With an accurate trajectory prediction, it is possible to calculate the delivery accuracy in a predicted fire, which does not have cumulative error corrections associated with the registration or adjusted fire. The delivery accuracies considered in this thesis are Mean Point of Impact (MPI) related to aiming errors and precision errors related to the dispersion caused by ballistics effect. Finally, the trajectory and accuracy estimates are compared with NATO Armament Ballistics Kernel (NATO) and Joint Weapons Accuracy Model (JWAM) respectively, and the differences are of the order of 4 percent.

**KEYWORDS:** Indirect-Fire, Trajectory, Accuracy, Predicted Fire, Precision Error, Mean Point of Impact Error

## **EXPERIMENTAL INVESTIGATION OF PITCH CONTROL ENHANCEMENT TO THE FLAPPING WING MICRO AIR VEHICLE**

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**Master of Science in Engineering Science (Mechanical Engineering)-December 2006**

**Advisor: Kevin D. Jones, Department of Mechanical and Astronautical Engineering**

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

The mechanical pitching characteristics of the Naval Postgraduate School (NPS) flapping-wing Micro Air Vehicle (MAV), developed by Professor Kevin D. Jones, are studied experimentally through the use of constant temperature anemometry and force balance techniques. The MAV without the main fixed-wing is placed in a laminar flow field within a low speed wind tunnel, with the wake after the flapping wings characterized with a constant temperature anemometer and thrust generation measured by a load cell at various neutral angles, flapping frequencies, and free stream velocities. The experiments seek to determine the effects on the MAV propulsion when the neutral angle of attack of the flapping wings is varied. Flow visualization is also performed to better enhance understanding of the flow field across the pitched flapping wings.

**KEYWORDS:** Flapping-Wing Propulsion, Micro Air Vehicle, Unmanned Systems, Constant Temperature Anemometer, Low Reynolds Number

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## ENGINEERING SCIENCE

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### **DEVELOPMENT AND IMPLEMENTATION OF NEW CONTROL LAW FOR VISION BASED TARGET TRACKING SYSTEM ONBOARD SMALL UNMANNED AERIAL VEHICLES**

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**Vladimir N. Dobrokhodov, Department of Mechanical and Astronautical Engineering**

A new control law is being developed and implemented for the Vision Based Target Tracking (VBTT) system onboard a small unmanned aerial vehicle (SUAV). The new control law allows for coordinated SUAV guidance and vision-based target tracking of stationary and moving targets in the presence of atmospheric disturbances and measurements noise. The new control law is tested for its performance and stability in both the theoretical six degree-of-freedom (DOF) simulation and the Hardware in the Loop (HIL) simulation. Principal results show that realistic measures of performance of the control law are continuous and exhibit predictable degradation of performance with increase of target speed. Results are encouraging and comparable among theoretical predictions, actual hardware simulation results, and initial flight testing. The control law development, implementation, and trial processes and procedures are also examined and categorically documented in this thesis. This information will serve as future reference on the subject development, for provide better knowledge retention, continuation, and proliferation of the VBTT system.

**KEYWORDS:** Unmanned Aerial Vehicle, UAV, Autonomous Guidance, Target Tracking, Control, Vision Based Target Tracking, Simulink, Hardware in the Loop, Piccolo, xPC Target, PC-104

### **INCORPORATING TARGET MENSURATION SYSTEM FOR TARGET MOTION ESTIMATION ALONG A ROAD USING ASYNCHRONOUS FILTER**

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In support of TNT experiments, the Naval Postgraduate School (NPS) Unmanned Air Vehicle (UAV) laboratory has developed a Vision-Based Target Tracking (VBTT) system for a UAV. This system provides an autonomous target tracking capability, while simultaneously estimating the target's velocity and position. The accuracy of the existing system can be improved by providing external corrections to the target position estimation from the geo-rectification system (GIS). This thesis addresses the implementation of an asynchronous correction scheme into the target position estimation filter. The current autonomous position estimation algorithm provides 20-30 meters accuracy in a 10-20 second interval. The Perspective View Nascent Technologies (PVNT) system is expected to provide target position accuracy of 1-2 m. However, a delay of up to 10 seconds is expected. Therefore, in order to obtain rapid and precise geo-location of the target, a new asynchronous correction technique that incorporates the more accurate PVNT data is proposed. To further improve the target motion estimation, it is also proposed to incorporate a known road model into the filter and compare its performance with the original filter.

**KEYWORDS:** Small Unmanned Air Vehicle, Asynchronous Filter, Perspective View Nascent Technologies, Target Motion Estimation

# **MASTER OF SCIENCE IN HUMAN SYSTEMS INTEGRATION**

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## **A MODULE FOR EMPLOYING HUMAN SYSTEMS INTEGRATION INTO THE RAPID EQUIPPING FORCE (REF)**

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Second Reader: Jeffrey Schamburg, TRAC-Monterey**

The rapidly changing complexity of the Global War on Terrorism has changed the approach to equipping forward deployed military forces. Combatant Commanders conducting operations now require timely materiel solutions to enhance mission capabilities and reduce risk for individual soldiers. To address this challenge, the U.S. Army established the Rapid Equipping Force (REF) to assess emerging requirements, to propose solutions to those requirements, and to implement those solutions in an expedient time frame. Unfortunately, the REF lacks a consistent analytical methodology for developing alternative materiel solutions. To address the need for a Human Systems Integration analysis method, the authors develop an Assessment Based Rapid Acquisition Human Systems Integration (HSI) Analysis Tool (ABRAHAM) capable of generating tailored surveys and evaluating these surveys for unacceptable risks to soldiers. To validate ABRAHAM's concept and content, ABRAHAM is showcased in three Department of Defense settings: the Human Factors Engineering Technical Advisory Group, the REF, and the United States Marine Corps' Operational Test and Evaluation Activity. The ABRAHAM appears to fill a gap in the current library of HSI tools. Based on the feedback provided during the product showcases, there is sufficient interest and technological maturity to further develop ABRAHAM to serve both the traditional and rapid acquisition processes.

**KEYWORDS:** ABRAHAM, HSI Tools, HSI, Rapid Acquisition, Rapid Equipping Force, REF, Human Systems Integration, DoD Acquisition, Demetrius Mack, Leon Higgins

## **TOWARD AN IMPROVED METHOD OF HUMAN SYSTEMS INTEGRATION (HSI) EVALUATION IN DEFENSE ACQUISITION**

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Each of the domains of Human Systems Integration (HSI) is, of itself, a discipline with vast amounts of research, analytic techniques, educational programs, and methods for evaluating the effectiveness of the system with respect to the specific domain. Relatively recently, domains with a logical similarity have been the focus of interest for researchers studying the plausibility of creating evaluative tools that take into account the constraints of multiple domains. This interest has led to the creation of various tools with which acquisition professionals can more accurately determine the impact of design decisions on the system as a whole. However, no single tool has yet been created that takes into consideration the constraints of all the domains encompassed by HSI. The development of such a tool would give decision-makers the ability to quickly and accurately determine the system-wide trade-offs associated with changes in a single domain.



In order for this to occur, an in-depth study of the current tools associated with each of the HSI domains must be conducted. The most accurate tools from each domain must be integrated with a single interface. However, this step will only be realized after a common language has been identified that can speak to the effectiveness of the system in each of the domains. Finally, the human interface with the tool must be intuitive, and designed with the end-user in mind.

This study identifies the various resources currently available for evaluating each of the HSI domains. These resources are compiled in a searchable database for use by the HSI professional in the planning of HSI evaluations. Following a description of how HSI relates to the Department of Defense acquisition process, the design effort to produce an overarching interface is presented. This interface would allow the acquisition professional to evaluate the trade-offs between all relevant domains and make well-informed decisions with respect to the overall effectiveness of the human in the system. Next, a plan for insertion of the process and software into the acquisition community, making the tool available to all acquisition professionals, is discussed. Finally, the limitations of the present study are discussed and recommendations for future research are provided.

**KEYWORDS:** Human Systems Integration, Defense Acquisition, HSI Analyst, Program Management

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

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## **DESIGN AND IMPLEMENTATION OF A PROTOTYPE ONTOLOGY AIDED KNOWLEDGE DISCOVERY ASSISTANT (OAKDA) APPLICATION**

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The World Wide Web (WWW) has become a major source of easily accessible information for students, professionals, researchers, and the general public. However, the volume of information available through the Web is so overwhelming that it is not unusual to get tens of thousands of “hits” when conducting a relatively simple search. Most existing search techniques use brute force based on keyword matches to find related Web pages. While the enormous speed of search engines improves the efficiency of such methods, effectiveness is not improved.

The objective of this thesis is to construct and test an ontology-based application to help users identify the most pertinent keywords for a search. By navigating ontologies that describe domains of interest, users are assisted in finding a relevant set of key terms that aid the search engines in narrowing, widening, or refocusing a Web search. Specifically, the thesis develops an ontology-aided Web search assistant prototype to help users enhance the relevance and precision of the returned results through the use of a context provided by ontologies associated with each search.

**KEYWORDS:** Owl Aided Internet Search Knowledge Base Discovery Description Logics Ontology

## **PERFORMANCE AND USAGE OF BIOMETRICS IN A TESTBED ENVIRONMENT FOR TACTICAL PURPOSES**

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The Naval Postgraduate School’s tactical-network topology (TNT) experiments seek to develop, implement, and identify a sensor-unmanned vehicle network and network-centric operations to assist Department of Defense warfighters in the global war on terrorism. Using biometric data for rapid identification of high-value targets in ground and maritime-interdiction operations is critical to the emerging special-operation concept. The goal is to explore solutions and operational constraints associated with biometrics-data analysis and rapid identification by means of ad hoc, self-forming, sensor-unmanned-vehicle wireless networks.

The objectives of this thesis are to look at how biometrics perform in a test bed environment that is simulating a real special-operations environment in theatre. This thesis is meant to explore and explain the biometrics process conducted on top of the tactical network and to evaluate its performance.

This thesis provides the process model for biometrics identification in the tactical-networks environment.

This thesis also evaluates the length of time it takes to transmit the fingerprint data from the field to the Automated Biometric Identification System (ABIS) database, with the identification result sent back to the field. The longest time observed is 70 minutes (using low-bandwidth satellite communications), while the shortest time is four minutes for reachback to ABIS and two minutes for a local database.

**KEYWORDS:** Biometrics, Automated Biometric Identification System, American National Standards Institute, National Institute of Standards and Technology, Electronic Biometric Transmission Specification, Electronic Fingerprint Transmission Specification, Cross Match, Tactical Network Topology, 802.16, Mesh, Iridium Satellite, United States Special Operations Command, Maritime Interdiction Operations

# **MASTER OF SCIENCE IN INFORMATION OPERATIONS**

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## **PAKISTAN, MADRASSAS, AND MILITANCY**

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**Master of Science in Information Operations-June 2007**

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Following the terrorist attacks of September 11, 2001, the U.S. government has become increasingly concerned with madrassas, Islamic schools of religious education in Central and South Asia. U.S. Secretary of Defense Donald Rumsfeld and Secretary of State Colin Powell denounced these religious seminaries as radical institutions that produce Islamic jihadists capable of threatening U.S. national security and interests.

This thesis examines the history and current evidence available on madrassas. Specifically, it analyzes their historical evolution and reaction to domestic, regional, and international developments. It finds that there is little evidence to connect madrassas to transnational terrorism, and that they are not a direct threat to the United States. However, Pakistani madrassas do have ties to domestic and regional violence, particularly Sunni-Shia sectarian violence in Pakistan and the Pakistani-Indian conflict in Kashmir, making them a regional security concern. This thesis argues that the best path for combating religious militancy in madrassas is by helping to create better alternatives to madrassa education, including state run and private schools, and not by targeting madrassas directly.

**KEYWORDS:** Pakistan, Madrassas, Militancy, Sectarian Violence, Trans-National Terrorism, Regional Jihad, American Perspective



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

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## **THE RELATIONSHIP BETWEEN NAVAL-AVIATION MISHAPS AND THE SQUADRON- MAINTENANCE SAFETY CLIMATE**

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

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David Annis, Wachovia Treasury**

Naval aviation has been known for over half a century as being one of the most fascinating professions. Although aircrew may always play a role in the mishap rate, the Navy has shifted its focus to the aviation-maintenance safety climate as a possible indicator of a future mishap. The School of Aviation Safety developed and implemented a survey, the Maintenance Climate Assessment Survey (MCAS), to assess the safety climate of naval-aviation squadrons. Researchers have begun reviewing the possible direct relationship between the maintainer, how they view their squadron's climate, and aviation mishaps. This thesis examines the construct of the Squadron Maintenance Safety Climate survey and its relationship to aviation mishaps. The raw data employed includes MCAS responses from 126,058 maintainers between August 2000 and August 2005. This study finds that the MCAS survey construction needs to be revised. The findings are substantial to verify that most questions are formulated to focus on the same factor. Since the survey requires reconstruction, the question of whether it can determine the likelihood of mishaps is not visited. Revising the survey, based on psychometrics, may produce more significant results and gauge maintenance safety climate based on separate and distinct factors.

**KEYWORDS:** Safety Climate, Safety Culture, Maintenance Safety Climate, Maintenance Safety Culture, Naval Aviation, High Reliability Organizations, Maintenance Climate Assessment Survey, Operational Risk Management, Survey Construction, Factor Analysis

## **THE INFLUENCE OF LEADERSHIP ON MORALE AT THE UNITED STATES NAVAL ACADEMY**

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The purpose of this thesis is to quantitatively analyze the relationship between midshipman leadership and morale at the United States Naval Academy. The goal is to determine if there is a specific set of leadership characteristics that directly contribute to positive company morale within the brigade of midshipmen. The study is quantitative and uses the Naval Academy Brigade Climate survey as its primary instrument. The results of this effort indicate that leadership characteristics that are centered on equality and fairness have a statistically significant influence on a unit's morale. Additionally, the thesis provides recommendations for clarifying the definition of morale in a military context, along with recommendations for shaping survey questions when attempting to measure morale.

**KEYWORDS:** Morale, Leadership, Midshipmen, United States Naval Academy



# MASTER OF SCIENCE IN MANAGEMENT

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## **COMMON CENTS? THE ROLE OF PENNIES IN THE U.S. ECONOMY**

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**Master of Science in Management-December 2006**

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

This thesis analyzes the impact that the elimination of pennies would have on the U.S. economy. This analysis is then compared to the Department of Defense's policy of not utilizing pennies in any of its overseas bases, and examines the pros and cons of this course of action on the exchanges and their customers. The objective of this thesis is to identify the financial burden, if any, of maintaining pennies in the U.S. currency to both the government and its citizens. The body of this thesis explores whether or not the U.S. government should continue the production and use of pennies or if the DoD's model could work in the greater economy. This thesis finds that the soundest approach the government could take to deal with this issue is the current legislation proposed by Arizona representative Kolbe, who proposes that the government stop producing pennies, and that businesses utilize the rounding approach to deal with all transactions ending in cents.

**KEYWORDS:** Rounding Approach, COIN Act, Pogs, Pennies, Copper, Zinc, Seigniorage, Cent, Jingle Runs

## **SIMULATING THE EFFECTIVENESS OF AN ALTERNATIVE SALARY-AUCTION MECHANISM**

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

This research simulates the effectiveness of an alternative auction mechanism for assignment incentive pay (AIP) that has the potential to reduce the Department of Defense's cost. A recent thesis studying the application of salary auctions and matching in an assignment setting determined that there are complications in an assignment auction that affect the incentive of bidders to submit a truthful valuation of the jobs. An alternative auction mechanism that combines elements of both auction theory and matching is proposed to overcome these complications. This study further defines this alternative auction mechanism and presents a simulation setup for testing the effectiveness of the mechanism. Simulation is carried out and the mechanism is evaluated based on defined operational performance and efficiency measures. The objective of this thesis is to evaluate the benefits of the alternative auction mechanism to the DoD. The proposed mechanism quickly converges to an efficient solution, though it involves a tradeoff between truth revelation (bid manipulation) and cost effectiveness; the more cost effective variant of the mechanism introduces an opportunity for bidders to manipulate their bids.

**KEYWORDS:** Auctions, Two-Sided Matching, Assignment Incentives, Simulation





# **MASTER OF SCIENCE IN MECHANICAL ENGINEERING**

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## **PROCESSING AND CHARACTERIZATION OF NITI SHAPE-MEMORY, ALLOY-PARTICLE REINFORCED SN-IN SOLDER**

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

**Advisor: Indranath Dutta, Department of Mechanical and Astronautical Engineering**

In the typical packaging of a printed circuit board, the tiny-yet-critical solder joints provide both electrical connection and mechanical support for the silicon chips and their substrate. These solders are subjected to serve thermo-mechanical strains during usage, and the most common failure arises from thermo-mechanical fatigue (thermal cycling). This is due to the mismatch in the coefficient of thermal expansion between the chip and the packaging substrate.

In previous work, it was proposed that reinforcement of solder by NiTi shape memory alloy particles to form smart composite solder reduces the inelastic strain of the solder and, hence, may enhance the low cycle fatigue life of the solder. In this thesis, a new fabrication process for incorporating NiTi particles (10 vol.% NiTi) into Sn-In solder (80Sn-20In) using liquid phase sintering is developed. The microstructures of the solders are characterized. The behavior of the solder joints during thermo-mechanical cycling is also characterized and the results show that the shear stress induced in the composite solder joint is significantly reduced relative to that in the monolithic solder joint due to the generation of a back-stress associated with the B19'  $\rightarrow$  B2 phase transformation of the NiTi particles during the heating part of the cycle. This causes an appreciable reduction of the total inelastic strain range during cycling.

**KEYWORDS:** Solder, Shape Memory Alloy, NiTi, Tin, Indium, Electronic Packaging, Thermo-Mechanical, Thermal Cycling, Inelastic Strain

## **A FIRST REPORT ON ELECTROMIGRATION STUDIES AT A MODEL COPPER-ALUMINUM RAILGUN CONTACT**

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The purpose of this thesis is to develop an experimental methodology to determine the effects of electromigration on the aluminum microstructure of the railgun armature. An experimental system that allows simulation of an Al armature between two Cu rails with surface "skins" is devised. The system is designed small enough such that only small current (<10A) is necessary to produce the large current densities typically found in railguns, and is able to simulate the skin effect on both the Cu rails and Al armature under static, long-term testing conditions. In this method, the effects of electromigration are discerned clearly, in dissociation from various movement-related damage phenomena. The aluminum from the armature quickly reaches its melting point via Joule heating due to high contact resistance at the armature-rail contact. Once liquid aluminum is formed, it rapidly migrates along the copper rail towards the negative terminal. This transport of liquid aluminum along the copper rails is attributed to electromigration of the liquid under the influence of the direct electric field. Once the aluminum begins to be transported along the rail towards the cathode terminal, it alloys with the copper rails and the resistance steadily increases in the circuit. Electromigration is shown to be a contributing factor to the degradation of aluminum armatures performance and copper rails lifespan in the railgun.

**KEYWORDS:** Railgun, Electromigration, Current Density, Thin Films

**CELLULAR AUTOMATA: AN APPROACH TO WAVE PROPAGATION AND  
FRACTURE-MECHANICS PROBLEMS**

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

**Advisor: Young W. Kwon, Department of Mechanical and Astronautical Engineering**

The cellular-automata (CA) method is based on the idea that the macroscopic behavior of a system can be captured by using simple local rules running at a microscopic level. In other words, a system can be modeled by means of simple local rules that govern the behavior of the whole system. In this thesis, a local CA rule set is introduced and a methodology is developed to model physical systems that are governed by one- and two-dimensional wave equations. One-dimensional systems are also successfully modeled by using CA and finite-element method (FEM) techniques working as coupled, whereas two dimensional systems could only be modeled in an error margin due to the variation of the introduced time scaling factor when external forces are involved. Also, the applicability of the CA method to fracture mechanics problems is investigated.

**KEYWORDS:** Cellular Automata, Wave Propagation, Crack Propagation, Cellular Automata, FEM Coupling

**DESIGN, MODELING, AND PERFORMANCE OF A SPLIT-PATH, JP-10/AIR-PULSE-  
DETONATION ENGINE (PDE)**

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

**Mechanical Engineer-December 2006**

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

The initiation of a detonation in pulse-detonation engines (PDE) has been identified as one of the critical and enabling technologies for PDEs. In particular, the initiation of practical fuel-air mixtures containing liquid droplets without supplementary oxygen or other high-loss mechanisms is a capability that could enable the PDE to exceed the performance of ramjets and expendable turbo-machinery based systems. Although past engine designs have relied upon a sensitive fuel/oxygen initiator unit or unrealistic gaseous fuels, such as ethylene and propane, a PDE is designed and partially tested that eliminates the requirement for supplementary oxygen and enables the use of a JP-10, high-density liquid fuel. Airflow through segments of this PDE is simulated using Computational fluid dynamics and experimentally evaluated in the laboratory at simulated flight conditions, including supersonic cruising conditions. The spiral-lined initiator demonstrates a lower total pressure loss when compared to the geometry with rings, and thus is the preferred initiator configuration. Experimental values for the turbulence are found to be significantly lower than the computed values at similar conditions when using the  $k-\epsilon$  model. Finally, successful ignitions of the JP-10/Air initiator at frequencies of up to 20 Hz are experimentally demonstrated.

**KEYWORDS:** Pulse Detonation Engines, PDE, PDE Ignition, Transient Plasma Ignition, TPI, Refresh Mach Number, Split Path, JP-10

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# MECHANICAL ENGINEERING

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## COMPUTATIONAL INVESTIGATION OF FLAPPING-WING PROPULSION FOR A MICRO AIR VEHICLE

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The low Reynolds-number aerodynamics of the flapping-wing micro-air vehicle (MAV) developed at the Naval Postgraduate School by Max Platzer and Kevin Jones is studied numerically. The dynamic mesh simulation model of the full multi-wing configuration, which consists of a fixed wing and a pair of aft-position, opposed, pitch/plunge flapping wings, is developed using an advanced computational fluid dynamics (CFD) code that is available commercially. The unsteady flow fields, wake structures, and forces are determined by solving the incompressible Navier-Stokes equations, and the results are compared to past experimental observations. The results are encouraging and provide impetus for future computational optimization studies on the NPS flapping wing MAV.

**KEYWORDS:** Computational Fluid Dynamics, CFD, Flapping Wing Propulsion, Unsteady Aerodynamic, Micro Air Vehicle

## TETHERED OPERATION OF AUTONOMOUS AERIAL VEHICLES TO PROVIDE EXTENDED FIELD OF VIEW FOR AUTONOMOUS GROUND VEHICLES

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Second Reader: Anthony J. Healey, Department of Mechanical and Astronautical Engineering

This thesis is part of the ongoing research conducted at the Naval Postgraduate School to achieve greater collaboration between heterogeneous autonomous vehicles. The research addresses optimal control issues in the collaboration between an unmanned aerial vehicle (UAV) and autonomous ground vehicles (AGV). The scenario revolves around using the camera onboard the UAV to extend the effective field of view of the AGV. For military operations, this could be helpful in improving security for convoys and riverine patrols. Three main problems are addressed in this thesis. The first problem deals with the design of a UAV control law that takes into consideration the relative speed differences between the UAV and the AGV. In this thesis, the UAV is assumed to have a greater speed compared to the AGV. The second problem is the keystone-field-of-view projection effect of the UAV's onboard camera onto the earth. The image captured by the camera is distorted due to the view angle of the camera from a high elevation. The third problem addressed is control of the location of the UAV to ensure the reliability of the communication network between the UAV and the AGV. The communication is assumed to be a linear function of the relative positions of the UAV and the AGV.

**KEYWORDS:** Tether Control, Keystone Effect, Autonomous Vehicles, Unmanned Aerial Vehicles, Unmanned Surface Vehicles

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## MECHANICAL ENGINEERING

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### **FRICITION STIR PROCESSING PARAMETERS AND PROPERTY DISTRIBUTIONS IN CAST NICKEL-ALUMINUM BRONZE**

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Cast nickel-aluminum bronze (NAB) alloy is specified for many marine applications, including ship propellers, due to its excellent corrosion-resistance combined with acceptable mechanical properties. Friction-stir processing (FSP) can be used to improve the alloy's mechanical properties by localized microstructure modification in the cast material. FSP converts an as-cast microstructure to a wrought condition in the absence of macroscopic shape change, closes porosity, and provides a means to surface harden the castings. The closure of porosity near the surface of the material may shorten the manufacturing and processing time for ship propellers. The surface hardening of cast NAB alloy can be used to increase the wear life of ship propellers. Rockwell Scientific Corporation (now Teledyne Scientific Corporation) supplied three nickel-aluminum bronze-alloy plates, which have been friction-stir processed in a raster pattern under a Defense Advanced Research Project Agency (DARPA) project. Each plate was processed using a different tool RPM and IPM (inches per minute of transverse) combination. Miniature tensile samples are sectioned from the FSP zone and surrounding base metal and mechanical property distributions are determined in these regions. The material within the FSP zone exhibits consistently higher yield strengths, ultimate tensile strengths, and ductilities than the as-cast base metal.

**KEYWORDS:** Friction Stir Processing, Nickel Aluminum Bronze, NAB, Raster Patterns, Transformations, Welding, Microstructure-Mechanical Property Relationships

### **DYNAMIC RESPONSE OF A CATAMARAN-HULLED SHIP SUBJECTED TO UNDERWATER EXPLOSIONS**

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Surface-ship shock trials play an essential role in ship testing and evaluation (T&E) and live-fire testing and evaluation (LFT&E) requirements for the lead ship of each new-construction, shock-hardened ship class. While these trials are necessary to evaluate the vulnerability and survivability of the ship, they are very expensive, require extensive time for planning and coordination, and pose serious danger to the crew, ship, and marine environment. Thus, computer modeling of the ship structure, surrounding fluid, and virtual shock environment by utilizing the finite-element method offers a valuable design tool and an alternative to these tests.

This thesis investigates the response of a catamaran-hulled ship subjected to an underwater explosion (UNDEX) by creating a virtual UNDEX environment based on the modeling and simulation methodology established by the shock and vibration computational laboratory at the Naval Postgraduate School. In previous works, all the structural models were monohulled ships and there have been concerns about the feasibility of creating the coupled fluid and catamaran-hulled model. This thesis studies the effect of an additional hull and of the gap between two hulls on the dynamic response of the ship, as well as the effect of the charge location.

**KEYWORDS:** Underwater Explosion, Shock and Vibration, Modeling and Simulation, M&S, Ship Shock, UNDEX, Shock Response, Ship Shock, Sea TENTACLE

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# MECHANICAL ENGINEERING

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## ANALYSIS AND TUNING OF A LOW COST INERTIAL NAVIGATION SYSTEM IN THE *ARIES* AUTONOMOUS UNDERWATER VEHICLE

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Autonomous-underwater-vehicle navigation is a complex problem of state estimation. Accurate navigation is made difficult due to a lack of reference navigation aids or use of GPS, which could establish a vehicle's position. Accurate navigation is critical due to the level of autonomy and range of missions and environments into which an underwater vehicle may be deployed. Navigational accuracy depends not only on the initialization and drift errors of the low-cost inertial-motion unit (IMU) gyros and the speed over ground sensor, but also on the performance of the sensor-fusion filter used.

This thesis presents the method by which an extended Kalman filter (EKF) is tuned after installation of an IMU in the *ARIES* autonomous underwater vehicle. The goal of installing the IMU, analyzing the navigational results, and tuning the EKF is to achieve navigational accuracy in the horizontal plane with a position error of less than one percent of distance traveled when compared with GPS. The research consists of IMU installation and software modifications within the vehicle to fully realize the design goal. Data collection and analysis are conducted through field experiments and computer simulation. A significant result of this work is the development of a pseudo-adaptive algorithm to vary the measurement noise values in selected channels to force a desired response in the filter and improve accuracy and precision in the state estimates.

**KEYWORDS:** Navigation, Underwater Vehicle, AUV, *ARIES*, Kalman Filter, Extended Kalman Filter, IMU, Inertial Navigation System

## EXPERIMENTAL INVESTIGATION AND NUMERICAL PREDICTION OF THE PERFORMANCE OF A CROSS-FLOW FAN

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The concept of a fan-wing aircraft configuration for the purpose of vertical takeoff and landing has drawn much attention. Recently, investigation revealed that a cross-flow fan (CFF) was capable of the necessary propulsion. Several characteristics of the off-design performance of a CFF were experimentally measured, but insufficient numerical predictions were obtained.

In the present study, the commercial computational fluid dynamics (CFD) software ANSYS CFX is employed to calculate the unsteady flow through a CFF with a sliding mesh incorporated. The results of the CFD demonstrate the need to re-investigate the cross-flow fan with 12-inch diameter, 1.5-inch span, and 30 blades. Additional measurement locations are implemented to carry out a more accurate experiment. A new digital-sensor array is used to record the pressures within the experiment, which contribute to the high fidelity of the present data. Successful comparisons are made between the predicted and measured performance at various rotational speeds from an open throttle position to a setting at stall. Visualization of the computed flow-field show where stall occurred, both within the rotor and in the exhaust duct.

**KEYWORDS:** Cross-Flow Fan, Computational Fluid Dynamics, CFD, Vertical and Short Takeoff and Landing, V/STOL



# MASTER OF SCIENCE IN METEOROLOGY

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## RESIDUAL-MEAN ANALYSIS OF THE AIR-SEA FLUXES AND ASSOCIATED OCEANIC MERIDIONAL OVERTURNING

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The dynamic response of the oceanic mixed layer to thermodynamic forcing at the sea surface is analyzed in order to describe the pattern of oceanic meridional overturning. The technique proposed in this study is based on residual-mean theory, which takes into account the transport of buoyancy and tracers by transient eddies. From the observed air-sea density flux and mixed-layer density distributions, the two components of the meridional-overturning circulation (MOC) corresponding to the adiabatic (along-isopycnal) advection and the diabatic (cross-isopycnal) flux are estimated. Calculations are performed for the global ocean and, additionally, for each oceanic basin. The derived method extends the Walin (1982) water mass transformation theory, and permits, for the first time, assessment of the strength of the MOC adiabatic component from sea-surface data.

This study offers a statistical description of the atmospheric and oceanic databases and gives some suggestions for the choice of specific datasets. In particular, the two most reliable atmospheric climatology databases (ECMWF and NCEP/NCAR re-analyses) are compared, and the impact of their inaccuracies on the MOC calculations is evaluated.

The results presented in this paper are consistent with the pattern of thermohaline circulation estimated from in-situ measurements and models. They also support the previous estimates of diapycnal volume flux by the Walin-type calculations. Furthermore, they suggest that the global thermohaline circulation is dominated by the adiabatic advection in the ocean interior.

One of the goals of the data-analysis and numerical-modeling effort is to explain the role of mesoscale variability in the dynamic coupling of the ocean and the atmosphere. Properties of oceanic thermal fronts and eddies determine undersea warfare (USW) tactics in the areas of high mesoscale activity, and therefore, efforts to predict their distribution and strength are directly related to the Navy's research interests.

**KEYWORDS:** Thermohaline Circulation, Meridional Overturning Circulation, Residual-Mean Theory, Air-Sea Fluxes, Surface Density Flux, Mixed-Layer Density, ECMWF, NCEP/NCAR

## OCEANIC MIXED-LAYER RESPONSE TO GAP-WIND SCENARIOS

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This study focuses on understanding the oceanic response to gap outflow and the air-sea interaction processes during the gap wind event between February 26 and 28, 2004 over the Gulf of Tehuantepec, Mexico. The U.S. Navy's coupled ocean atmospheric mesoscale prediction system (COAMPS) and the Naval Postgraduate School's ocean mixed layer (OML) model are used to simulate the gap wind event and the temporal/spatial evolution of ocean response. Satellites, aircraft, and airborne expendable bathythermograph (AXBT) measurements of the sea surface temperature and the water temperature profiles



obtained during the Gulf of Tehuantepec experiment (GOTEX) are used to aid the analysis of model results and define model initial conditions.

Results from the OML suggest sizable sea-surface temperature (SST) change as a result of enhanced upper-ocean mixing along the jet axes. Sensitivity tests show the dominant effects of surface-heat flux in generating upper-ocean mixing, while mechanical forcing by the wind jet plays a lesser role. Sensitivity tests also suggest that the thermocline structure is the key factor in determining the magnitude of the ocean response, while variations in SST are not sensitive to upwelling for time scale of several days. COAMPS simulations and satellite SST images confirm the existence of a secondary gap outflow in the area.

**KEYWORDS:** Ocean Mixed Layer, Gap Winds, Sea Surface Temperature, Gulf of Tehuantepec, Air-Sea Coupled System, Gulf of Tehuantepec Experiment, GOTEX

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

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## **SENSITIVITY OF BOTTOM TOPOGRAPHY ON THE DYNAMICS AND SOUND SPEED STRUCTURE IN THE NORTHERN CANARY CURRENT SYSTEM**

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The knowledge of the ocean environment, especially its littoral/coastal waters, is important for current and future Naval operations. In particular, an accurate description of the mesoscale variability of the surface and subsurface currents is essential for optimizing naval missions. This study determines that different types of topographic smoothing and the addition of a volume constraint to a sigma-coordinate model significantly influences the generation, evolution, and maintenance of not only the surface and subsurface currents, but also other features (upwelling, meanders, eddies, filaments, Mediterranean outflow, and meddies) in the Northern Canary current system (NCCS). The NCCS is chosen for this study for its classical upwelling and equator-ward surface current, as well as the unique impact of the Mediterranean outflow. The sound-speed structure of these features is examined to establish which regions of the NCCS experience the largest changes in sound speed and the most intense gradients. This study demonstrates that features of classic littoral/coastal eastern-boundary current systems like the NCCS have an important impact on sound-speed structure, which can significantly impact naval sonar operations.

**KEYWORDS:** Primitive Equation Model, Northern Canary Current System, Sigma-Level, Princeton Ocean Model, POM, Sound Speed, Eastern Boundary Current, Meddies, Eddies, Currents, Upwelling, Undercurrent, Meander, Filaments

## **INCREASING RANGE AND LETHALITY OF EXTENDED-RANGE MUNITIONS USING NUMERICAL WEATHER PREDICTION AND THE AUTONOMOUS UNMANNED VEHICLE WORKBENCH TO COMPUTE A BALLISTIC CORRECTION**

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Extended-range munitions (ERMs) are gun-launched rocket-boosted munitions having an effective range over 27 km. In accordance with Sea Power 21 and the Marine Corps' requirements for sea-based fire support, three ERMs are being developed. The purpose of this work is to increase the range and lethality of these munitions by applying environmental effects when computing the projectiles' trajectory.

A broad review of artillery and munitions literature reveals that historically 66% of ballistic error can be attributed to meteorological factors. The most important factors are wind (speed and direction), temperature, and pressure. It has also been shown that global atmospheric numerical weather prediction

(NWP) data typically outperforms the traditional radiosonde data and is suitable for use in ballistic corrections.

Forecasted NWP products provided by the Fleet Numerical Meteorology and Oceanographic Center (FNMOC) are integrated using the joint meteorology and oceanographic (METOC) broker language (JMBL) into a five-degree-of-freedom (5DOF) aerodynamic model within the autonomous unmanned vehicle (AUV) workbench, producing a ballistic correction (BALCOR) for the munition. This new capability can significantly enhance naval-gunfire effectiveness, since the BALCOR increases the munitions' range and the ability to apply kinetic energy onto the target rather than using it to maneuver to the target.

**KEYWORDS:** Long-Range Projectiles, Extended-Range Munitions, ERM, Ballistic Trajectory Extended-Range Munition, BTERM, Extended-Range Guided Munition, ERGM, Long-Range Land Attack Projectile, LRLAP, Ballistics, Fleet Numerical Meteorology and Oceanography Center, FNMOC, Numerical Modeling, Numerical Weather Prediction, NWP, Navy Operational Global Atmospheric Prediction System, NOGAPS

# **MASTER OF SCIENCE IN OPERATIONS RESEARCH**

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## **EXTENDING ORTHOGONAL AND NEARLY ORTHOGONAL LATIN HYPERCUBE DESIGNS FOR COMPUTER SIMULATION AND EXPERIMENTS**

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Second Reader: Alejandro S. Hernandez, Department of Operations Research**

Computational experimentation is an important tool of the military. It provides useful insights at a lower cost of time and money when compared to physical experiments. Consequently, computational experiments are used to evaluate weapon systems for technology acquisition, to examine tactics, and to help select among alternatives for military operations and war plans.

Experiments often consist of a large number of factors. Advancements in computing power and design of experiments (DOE) for simulation allow for the investigation of more of these factors through computational experiments, achieved with less expense in time, effort, and money. Within the framework of DOE, this thesis investigates orthogonal Latin hypercube (OLH) and nearly orthogonal Latin hypercube (NOLH) designs. These designs are often used for computational experiments. This research greatly expands upon the size (in terms of runs and, especially, variables) of the available OLH and NOLH designs. Previously, the largest catalogued OLH and NOLH designs were a maximum of 29 variables and 257 runs. OLH and good space-filling NOLH designs for up to 512 variables in 1025 runs are now available. This thesis also develops an algorithm for handling discrete factors with the designs. Finally, the effects of stacking multiple OLH designs into one larger design are quantified. All of the designs developed in this research are available at the Simulation Experiments and Efficient Designs Center (SEED) website (<http://harvest.nps.edu>).

**KEYWORDS:** Design of Experiments, Experimental Designs, Latin Hypercube Designs, Orthogonal Latin Hypercube Designs, Orthogonal, Space-Filling, Computer Simulation and Experiments

## **MODELING COGNITIVE AND TACTICAL ASPECTS IN HUNTER-KILLER MISSIONS**

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Kyle Lin, Department of Operations Research**

**Second Reader: Patricia A. Jacobs, Department of Operations Research**

In this thesis, a Markov-based probability model for a human-operated system of aerial hunter-killers attacking time-sensitive targets is presented. The effect of two resources, time and supply of munitions, and some cognitive aspects of the human operator on the performance of the system in different operational scenarios, are explored. The combat mission is modeled as a sequence of engagements, each of which includes a classification process, followed by a firing decision and a shooting process. The model of the classification process addresses possible effects of stress on the operator's behavior and performance. Two shooting tactics are considered. The random-shooting tactic, which is memory-less and with no fire control, battlefield-damage assessment (BDA) capability, or mission-support systems, sets a benchmark for more effective shoot-look-shoot tactic, where resources are utilized more efficiently. The model represents various tactical parameters regarding rules of engagement and various mixes of resources. Applying the model on some real-world scenarios, mixes of resources and tactical engagement rules that enhance the effectiveness and efficiency of the combat mission are identified.

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## OPERATIONS RESEARCH

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**KEYWORDS:** Stochastic Model, Hunter-Killer, UCAV, UAV, TST, TCT, Air Operation, Target Acquisition, Shooting Strategy, Shooting Tactics, Fire Allocation, Markov Chain, Operational Planning, Cognitive, Decision Making under Time Pressure, Target Classification, Stress

### FLIGHT-REGIME-RECOGNITION ANALYSIS FOR THE ARMY UH-60A INTEGRATED-MECHANICAL-DIAGNOSTIC-SYSTEM USAGE

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Usage monitoring requires accurate regime recognition. For each regime, there is a usage assigned for each component. For example, the damage accumulated at a component is higher if the aircraft is undergoing a high G maneuver than in level flight. The objective of this research is to establish regime recognition models using classification algorithms. The data used in the analysis are the parametric data collected by the onboard system and the actual data, consisting of the correct regime, collected from the flight cards.

This study uses Rpart (with a tree output) and C5.0 (with a ruleset output) to establish two different models. Before model fitting, the data is divided into smaller datasets that represent regime families by subsetting using important flight parameters. Non-normal tolerance intervals are constructed on the uninteresting values; then these values in the interval are set to zero to be muted (e.g., excluded). These processes help reduce the effect of noise on classification. The final models have correct classification rates over 95%. The number of bad misclassifications is minimized (e.g., the number of bad misclassifications of a level flight regime as a hover regime is minimized), but the models are not as powerful in classifying the low-speed regimes as in classifying high-speed regimes.

**KEYWORDS:** Flight Regime Recognition, Classification Algorithms, C5.0, Rpart, Flight Regime Families

### USING DYNAMIC SUSTAINMENT TO DETERMINE THE IMPACT OF VARYING LEVELS OF RELIABILITY ON FUTURE COMBAT SYSTEMS' MAINTENANCE REQUIREMENTS

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The primary purpose of this thesis is to provide analysis for future reliability studies. This thesis assesses the value of the dynamic-sustainment simulation model as a logistics-modeling tool and demonstrates data analysis techniques that can potentially be applied to model results. The secondary purpose is to explore the impact on the maintenance system of varying levels of platform reliability as part of an ongoing effort to provide the Office of the Secretary of Defense with credible analysis for future combat system reliability.

The effects of a crew repair team having a high or low repair capability; having a fast or slow spare-parts delivery speed; having high, medium, or low system reliability; and high or low numbers of mechanics is measured on maintenance man-hours required at the end of a 72-hour scenario. Twenty-four treatments with varying levels of each factor are designed and imposed on four combat arms brigades. The fourth brigade has 70 percent more vehicles than the other three.

Significant effects of all factors except the number of mechanics are found with interaction between those factors. Spare-parts delivery speed is ranked high in terms of significance, followed by crew repair capability. Slow delivery speed reduces maintenance. Low reliability produces the most maintenance man-hours.

**KEYWORDS:** Dynamic Sustainment, Future Combat Systems

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# OPERATIONS RESEARCH

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## INVESTIGATING GROUND-SWARM ROBOTICS USING AGENT-BASED SIMULATION

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Second Reader: Chwee Seng Choo, DSO National Laboratories, Singapore

The concept of employing ground-swarm robotics has been proposed for future use in humanitarian de-mining, plume monitoring, searching for survivors in disaster sites, and other hazardous activities. More importantly in the military context, with the development of advanced explosive detectors, swarm robotics with autonomous search-and-detection capability could potentially address the improvised, explosive device (IED) problem faced by foot patrols, and aid in the search for hidden ammunition caches and weapons of mass destruction. The intent of this research is to leverage on agent-based simulation to model a ground robotic swarm on a search-and-detection mission in a semi-urban environment rigged with stationary IEDs. Efficient design of experiment (DOE) techniques and data farming are engaged to help identify controllable factors and capabilities that have the most impact on overall effectiveness. The focus of this thesis is to explore agent-based simulation applied to swarm robotics; the technological and algorithmic aspects are not considered. Results from the simulations provide several insights on the impact of both decision and noise factors on the performance of the swarm. Incorporation of virtual pheromones as a shared memory map is modeled as an additional capability that is found to enhance the robustness and reliability of the swarm.

**KEYWORDS:** Agent Based Modeling, ABM, Agent Based Simulation, Modeling and Simulation, Design of Experiment, DOE, Swarm Robotics, Map Aware Non-Uniform Automata, MANA, Adaptive Robots, Nearly Orthogonal Latin Hypercube, NOLH

## OPTIMAL MILITARY TRANSPORTATION IN A KOREAN THEATER

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Due to their high dependency on highway transportation, the Republic of Korea's (ROK) military and industry suffer from congestion, limited capacity (convoys in the military case), and high cost. This research develops an optimization model to guide the ROK's military planning using multi-modal transportation. The military-logistics-transportation model (MLTM) is applied to a realistic scenario. MLTM provides guidance on the optimal frequency of transportation services and the optimal routes for the freight. By comparing the solution of MLTM with current practice for wartime transportation planning (represented by a heuristic method), the MLTM can reduce the transportation costs up to 29%. This is enabled by the activation of multi-modal transportation and service sharing by multiple demands. Scenarios are analyzed in which either sea-port of debarkation (SPOD) where the supply originates has been shut down by enemy attacks. It is found that losing Busan SPOD is more damaging than losing Kwangyang SPOD.

**KEYWORDS:** Freight Transportation, Multi-Modal, Military Logistics Transportation Model, Service, Route, Section, Army Supply Requirements Scenario, Wartime Transportation Plan, Mixed Integer Programming, Optimization, Vehicle Routing Problem

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## OPERATIONS RESEARCH

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### **A METHODOLOGICAL APPROACH FOR CONDUCTING A BUSINESS-CASE ANALYSIS FOR THE JOINT DISTANCE SUPPORT AND RESPONSE (JDSR) ADVANCED-CONCEPT- TECHNOLOGY DEMONSTRATION (ACTD)**

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**Second Reader: David Meyer, Department of Operations Research**

The Joint Distance Support and Response (JDSR) is an advanced concept technology demonstration (ACTD) initiative approved by the United States Joint Forces Command (JFCOM). The purpose of ACTD is to exploit mature and maturing technologies and rapidly transit new capability to address military problems, while JDSR aims to establish a common tele-maintenance environment to improve the efficiency of field military services to support war fighters.

The operational concept of JDSR is to provide near real-time maintenance solutions in an operational fighting environment to enhance situational awareness of platforms' and weapon systems' operational status for the joint task force commander. This common joint service tele-maintenance capability is achieved through the use of advanced commercial technologies integrated with the services' ongoing development initiatives to provide four integrated functions: remote collaboration, information/knowledge sharing, remote weapon/platform diagnostics, and distant maintenance mentoring at the point of maintenance.

The purpose of this thesis is to analyze the cost savings and the benefits of implementing the JDSR capability. This thesis develops a recommended standard for performing business case analyses of J/ACTDs, including defining the analytic structure required in a business case report; and conducts the JDSR ACTD business case analysis, including a baseline analysis and an extensive sensitivity analysis.

**KEYWORDS:** Business Case Analysis, Joint Distance Support and Response, Advanced Concept Technology Demonstration

### **DESIGNING AND PREPOSITIONING HUMANITARIAN-ASSISTANCE PACK-UP KITS TO SUPPORT PACIFIC-FLEET EMERGENCY-RELIEF OPERATIONS**

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The 2006 *Quadrennial Defense Review* has emphasized the role of humanitarian assistance missions in winning the global war on terror. The U.S. Pacific fleet operates in an area prone to both terrorist recruitment and sudden-onset natural disasters that require humanitarian assistance and disaster relief operations. The U.S. Navy has unique capabilities to deliver first-response humanitarian assistance. This thesis develops and suggests pre-positions for humanitarian assistance pack-up kits, which contain emergency relief material commonly used in these missions, in order to expedite delivery to those impacted by a disaster.

**KEYWORDS:** Humanitarian Assistance, Logistics, Military Operations Other Than War, MOOTW, Logistics Planning Factors

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# OPERATIONS RESEARCH

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## COMMUNICATION ASPECTS IN URBAN TERRAIN

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The nature of warfare has changed dramatically during the last decade. Western armies are increasingly required to conduct complex operations in urban terrain against asymmetric threats. These opponents use cities and their inhabitants for cover and concealment. In such situations, modern equipped armies often cannot fully utilize many of their most powerful weapons. To overcome this situation, modern communication systems are being acquired and deployed to provide real-time reconnaissance; thereby attempting to neutralize the threat through enhanced situational awareness. This research addresses the potential impacts of communication from airborne sensors on assisting a convoy in finding its way through a hostile city quarter (based on Mazar-E-Sharif, Afghanistan) in which militia forces try to interdict them via street blockades and ambushes. The implementation is done in the agent-based simulation Map Aware non-uniform automata (MANA). Results show that the current MANA version is not sufficiently capable of handling routing problems in urban terrain. Specifically, the movement algorithm is “locally greedy” and not flexible enough to project into the future-as real human decision makers do. Many workarounds are developed to mitigate this limitation. The analysis shows that the number of blockades is the single most important factor in determining the convoy’s success. Of the communication factors, network latency has the most impact. For the convoy to effectively use the information, it needs to get from the sensor to the convoy in 11 seconds.

**KEYWORDS:** Agent-Based Model, MANA, Simulation, Design of Experiment, Communication, Urban Terrain, Network Centric Operation

## OPTIMIZED POSITIONING OF PRE-DISASTER RELIEF FORCE AND ASSETS

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**Second Reader: Theodore G. Lewis, Department of Computer Science**

Recent events in the United States and Pakistan have exposed the shortcomings of existing planning in relief and humanitarian assistance in the face of large-scale natural disasters. This thesis develops a two-stage stochastic optimization model to provide guidance in the pre-positioning of relief units and assets, where budget, physical limitations, and logistics are taken into account. Stochastic data include the number of survivors in each potential affected area (AA), the amount of commodities that needs to be delivered to each AA, and the transportation time from each relief location (which reflects scenarios where, for example, roads are blocked). As first-stage decisions, the expansion of warehouses, medical facilities, and their health care personnel, as well as ramp space to facilitate aircraft supply of commodities to the AAs, are considered. The second-stage is a logistic problem represented as a network, where maximizing expected rescued survivors and delivery of required commodities are the driving goals. This is accomplished through land, air, and sea transportation means (e.g., CH-53 helicopters configured for rescue missions), as well as relief workers. The model is successfully assessed on notional scenarios and is expected to be tested on realistic cases by personnel who are involved in relief planning.

**KEYWORDS:** Disaster Relief, Force Pre-Positioning Stochastic Programming



# **OPERATIONS RESEARCH**

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## **APPLICATION OF NEURAL NETWORKS TO PREDICT UH-60L ELECTRICAL-GENERATOR CONDITION USING IMD-HUMS DATA**

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In 2003, the U.S. Army began using the Integrated Mechanical Diagnostics Health and Usage Management System (IMD-HUMS), an integrated airborne and ground-based system developed by Goodrich Corporation, to support maintenance of the UH-60L. IMD-HUMS is responsible for collecting, processing, analyzing, and storing an enormous amount of vibratory and flight-regime data obtained from sensors located throughout the aircraft.

The purpose of this research is to predict failures of the UH-60L's electrical generators, applying artificial neural networks (ANN) on the IMD-HUMS-produced data. ANNs are data-based vice rule-based, thereby possessing the potential capability to operate where analytical solutions are inadequate. They are reputed to be robust and highly tolerant of noisy data. Software tools such as Clementine 10.0, S-Plus 7.0, and Excel are used to establish these predictions.

This research verifies that ANNs have a position in machinery condition monitoring and diagnostics. However, the limited nature of these results indicates that ANNs will not solve all machinery condition monitoring and diagnostics problems by themselves. They certainly will not completely replace conventional rule-based expert systems. Ultimately, it is anticipated that a symbiotic combination of these two technologies will provide the optimal solution to the machinery condition monitoring and diagnostics problem.

**KEYWORDS:** IMD-HUMS, Neural Networks, Back-Propagation, Learning Process, Clementine 10

# **MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY**

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## **EVALUATION OF ACOUSTIC-DOPPLER-CURRENT PROFILERS' WAVE MEASUREMENTS**

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Nearshore wave information is important to a variety of U.S. Navy operations in the littorals, including mine warfare, amphibious operations, small-boat operations, and Special Forces insertions. The objective of this thesis is to evaluate the accuracy of Teledyne RDI acoustic-doppler-current profilers (ADCP) in measuring wave height and direction spectra, so that the military can use these for routine wave measurements near shore. This study uses ADCP data collected in 25 and 45 m depths during NPS's fall 2003 nearshore-canyon experiment (NCEX) off La Jolla, California. Data are first corrected for dropouts. Next the data quality is verified through a consistency check on the redundant velocity measurements of opposing beams, an evaluation of high frequency spectral noise levels, and a comparison of velocity and pressure measurements using linear wave theory. Finally, wave height and direction spectra estimated from the ADCP data are compared to data from a directional wave buoy. The analysis reveals that the ADCP data can suffer from low signal-to-noise ratios in benign conditions and deeper water. Whereas the wave height estimates are sensitive to these errors, the wave direction estimates are surprisingly robust.

**KEYWORDS:** Undersea Warfare, Littoral Wave Measurements, ADCP, Ocean Waves

## **RESIDUAL-MEAN ANALYSIS OF THE AIR-SEA FLUXES AND ASSOCIATED OCEANIC MERIDIONAL OVERTURNING**

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The dynamic response of the oceanic mixed layer to thermodynamic forcing at the sea surface is analyzed in order to describe the pattern of oceanic meridional overturning. The technique proposed in this study is based on residual-mean theory, which takes into account the transport of buoyancy and tracers by transient eddies. From the observed air-sea density flux and mixed-layer density distributions, the two components of the meridional-overturning circulation (MOC) corresponding to the adiabatic (along-isopycnal) advection and the diabatic (cross-isopycnal) flux are estimated. Calculations are performed for the global ocean and, additionally, for each oceanic basin. The derived method extends the Walin (1982) water mass transformation theory, and permits, for the first time, assessment of the strength of the MOC adiabatic component from sea-surface data.

This study offers a statistical description of the atmospheric and oceanic databases and gives some suggestions for the choice of specific datasets. In particular, the two most reliable atmospheric climatology databases (ECMWF and NCEP/NCAR re-analyses) are compared, and the impact of their inaccuracies on the MOC calculations is evaluated.

The results presented in this paper are consistent with the pattern of thermohaline circulation estimated from in-situ measurements and models. They also support the previous estimates of diapycnal volume flux by the Walin-type calculations. Furthermore, they suggest that the global thermohaline circulation is dominated by the adiabatic advection in the ocean interior.

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## PHYSICAL OCEANOGRAPHY

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One of the goals of the data-analysis and numerical-modeling effort is to explain the role of mesoscale variability in the dynamic coupling of the ocean and the atmosphere. Properties of oceanic thermal fronts and eddies determine undersea warfare (USW) tactics in the areas of high mesoscale activity, and therefore, efforts to predict their distribution and strength are directly related to the Navy's research interests.

**KEYWORDS:** Thermohaline Circulation, Meridional Overturning Circulation, Residual-Mean Theory, Air-Sea Fluxes, Surface Density Flux, Mixed-Layer Density, ECMWF, NCEP/NCAR

### **EFFECT OF INTERNAL SOLITARY WAVES ON MINE DETECTION IN THE WESTERN-PHILIPPINE SEA, EAST OF TAIWAN**

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Upper-layer temperature in the western Philippine Sea near Taiwan is sampled using a coastal monitoring buoy with fifteen thermistors attached from 28 July-7 August 2005. Internal waves (IW) and internal solitons (IS) are identified using the empirical orthogonal function analysis. Without the IW and IS, the power spectra, structure functions, and singular measures (representing the intermittency) of the temperature field satisfy the power law with multi-scale characteristics at all depths. The IW does not change the basic characteristics of the multifractal structure. However, the IS changes the power exponent of the power spectra drastically, especially in the low wave number domain. It breaks down the power law of the structure function and increases the intermittency parameter. The physical mechanisms causing these different effects need to be explored further.

The comprehensive acoustic simulation system is applied to determine how the IS affect the mine detection by computing the transmission loss (TL) and the ray traces of range-dependent and range-independent cases during the IS period. The maximum TL difference is 20 dB. As a result, the mine detection probability is dramatically reduced to 1% of the original detection probability.

**KEYWORDS:** Western Philippine Sea, Internal Waves, Internal Solitary Waves, Mine Detection, Multi-Fractal Characteristics, Power Spectra, Structure Function, Singular Measures, Comprehensive Acoustic Simulation, CASS/GRAB Model

### **OBSERVED STATISTICS OF EXTREME WAVES**

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Amphibious landings and small-boat operations are normally conducted in benign wave conditions. An unexpected encounter with an isolated freak wave may damage equipment and prevent mission accomplishment. This study examines the occurrence of unusually large waves using datasets obtained with bottom-mounted pressure sensors and wave buoys in the DUCK 94, SHOWEX, and SAX 04 experiments. All of the experiments included wave records from high-energy events. After correcting the raw pressure data for hydrodynamic attenuation over the water column, the statistics of wave heights are evaluated and compared with the theoretical Rayleigh distribution of a narrow-band linear wave field.

Observations from deepwater sites follow the Rayleigh distribution well, even in extreme sea states, indicating that strong nonlinearity does not have a major effect on wave height statistics. However, during high-energy events at shallow-water sites, there are significantly less measured wave heights in the right-hand tail of the distribution of wave heights than the theoretical Rayleigh distribution would predict. These results show that waves become more homogeneous in height as they propagate into shallower water, possibly owing to breaking and nonlinear effects. While the observed wave statistics do not suggest a

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## PHYSICAL OCEANOGRAPHY

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frequent occurrence of freak waves, isolated large waves were indeed observed, even in benign conditions. Further studies are needed to assess their risk to Navy operations.

**KEYWORDS:** Freak Waves, Sea State, Ocean Waves, SAX04, DUCK94, SHOWEX, Nonlinear, Wave Buoys, Pressure Sensors, Histogram, Undersea Warfare

### **AIRBORNE HYPERSPECTRAL AND SATELLITE MULTISPECTRAL IMAGERY OF THE MISSISSIPPI GULF-COAST REGION**

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The compact, airborne, spectrographic imager (CASI) and the satellite moderate-resolution imaging spectroradiometer (MODIS) provide detailed information about the environment in which U.S. naval forces choose to operate. In recent years, environmental conditions have been a driving factor in preventing the detection of underwater objects like mines. Suspended sediments are an environmental condition of interest. Remote sensors provide an opportunity to detect suspended sediments in a region prior to the commencement of operations, and to better prepare the force while reducing time required to complete operations.

Monthly datasets collected using MODIS, from February 2005 to February 2006, show variations in weather patterns in the Mississippi Bight that cause the persistent presence of suspended sediments in certain areas of the Mississippi Bight. Major storm events (such as hurricanes) alter the location that suspended sediments persist in this region during hurricane season. MODIS with 250m-pixel resolution is capable of detecting large-scale suspended sediment plumes, while CASI with 1m-pixel resolution is capable of detecting very fine suspended sediment filaments and providing early warning of possible mine locations.

As the mine warfare fleet diminishes in size, CASI and MODIS, coupled with current sensors, may provide an increase in detection capability while reducing the workload of the ships. Continued research and study of suspended sediment transport during hurricane seasons would provide more information about how the environment changes.

**KEYWORDS:** Multispectral Imagery, Hyperspectral Imagery, Suspended Sediments, MODIS, CASI, USW, Mine Warfare

### **USING ACOUSTIC BACKSCATTER TO MEASURE SEDIMENT FLUX IN THE SURF ZONE**

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Transport of sediment in coastal regions directly impacts mine countermeasure operations and naval construction efforts. Wave induced shear stress in the surf zone is responsible for entraining sediment particles into suspension within the combined wave and current boundary layer, where momentum is imparted through highly nonlinear processes. Therefore, a detailed understanding of sediment flux processes in the surf zone is essential to accurately model net sediment transport.

This study examines the use of acoustic backscatter inversion as a means of measuring sediment concentration profiles. Measurements of sediment concentration and velocity profiles were made by a high-frequency Doppler-velocity profiler deployed on Black's Beach during the Nearshore Canyon Experiment (NCEX). Profiles of sediment flux are compared with hourly mean current measurements from a cross-shore/long-shore array of PUV sensors and two-dimensional planner images of the morphological evolution provided by a three-camera Argus video suite.

Observations from a seven-day period containing the development and evolution of a weak rip channel demonstrates that acoustic backscatter-inversion techniques, when calibrated with in situ sediment samples, provide high spatial and temporal resolution estimates of sediment concentration and fluxes into the thin wave boundary layer. These sediment transport measurements are correlated with observed mean currents and rip channel evolution, and show a strong morphological response to the sediment flux.

**KEYWORDS:** Sediment Flux, Sediment Concentration, Cross Shore Sediment Transport, Nearshore Currents, Acoustic Backscatter, Bistatic Coherent Doppler Velocimeter, BCDV, Scattering Attenuation, Nearshore Canyon Experiment, NCEX, Bed Echo, Rip Channel, Argus, Variance Image, Pressure-Velocity Sensor, PUV Sensor, In Situ Calibration

# **MASTER OF SCIENCE IN PROGRAM MANAGEMENT**

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## **LEAN IMPLEMENTATION AT WHITE SANDS MISSILE RANGE: A CASE STUDY OF LEAN THINKING APPLIED IN A GOVERNMENT ORGANIZATION**

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

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**Kenneth H. Doerr, Graduate School of Business and Public Policy**

In this joint applied project, the application of lean thinking at White Sands Missile Range, an Army Major Range and Test Facility Base (MRTFB) tasked with developmental test and evaluation (T&E) as its primary mission, is studied. A representative segment of leaders, managers, and working level lean implementers are interviewed, and 285 participants in lean events at White Sands are surveyed. A comprehensive, uniform set of questions is employed in the interviews and surveys to gain insight into significant expectations, questions, issues, concerns, difficulties, constraints, and uniquely governmental situations and circumstance related to this implementation. A massive and significant resulting dataset is organized and analyzed around emerging themes, including a linkage between lean and personnel cuts, management support of lean, small incremental benefit versus large bottom-line impact, process documentation, metrics and measurement, vision, urgency, and goals, uniquely governmental issues, and the lean process itself.

Relevant conclusions and recommendations are offered, based on those themes, which may significantly aid similar government organizations who are currently, or expectantly, engaged in lean implementations or other process improvement efforts. Those conclusions and recommendations are offered as academic and neutral examinations of real issues associated with an actual lean implementation. Notwithstanding the difficulties and complexities examined in this study, it is found that an overwhelming majority of participants believe there was broad incremental benefit from lean, that its cost was warranted and necessary, and that it absolutely should continue to be used as a tool to achieve greater efficiency, quality, and effectiveness in government business processes.

**KEYWORDS:** Lean, Lean Six Sigma, Process Improvement, White Sands Missile Range, Test and Evaluation, T&E, Major Range and Test Facility Base, MRTFB, Metrics, Process Documentation, Lean Thinking, Army, Army Test and Evaluation Command, ATEC, Developmental Test Command, DTC, Operational Test Command, OTC, Army Business Transformation, Army Transformation

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## PROGRAM MANAGEMENT

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### SOFTWARE INDEPENDENT VERIFICATION AND VALIDATION SIMPLIFIED

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Software independent verification and validation (SIV&V) has been in existence for some 40 years, and many people still know little about its existence. Software IV&V certifies the quality of software and independently validates and verifies that it meets or exceeds the customer's expectations. Independent V&V for component or element software development activities encompasses the following: 1) review and thorough evaluations of the software development, 2) review and comment on software documentation, 3) participation in all software requirements and design reviews, and 4) participation in software integration and testing for each software build. This thesis explores and explains the benefits and rationale for software independent verification and validation. It identifies SIV&V processes that are used to support acquisition weapon systems. "SIV&V Simplified" translates (into understandable terms) why SIV&V is considered "cheap insurance" and why it is needed. Additionally, this thesis serves as a tutorial, providing suggested policy and guidance, suggested software computer-aided software engineering (CASE) tools, criteria, and lessons learned for implementing a successful SIV&V program.

**KEYWORDS:** Software, Independent, Verification, Validation, SIV&V, Computer Aided Software Engineering, CASE Tools, Test and Evaluation, Requirements

### THE DEPARTMENT OF DEFENSE'S TRANSITION OF PROGRAM OF RECORD SYSTEMS FROM INTERNET PROTOCOL VERSION FOUR TO INTERNET PROTOCOL VERSION SIX

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The objective of this Joint Applied Project is to examine the technical, financial, and implementation aspects for Department of Defense transitioning program of record (POR) systems to Internet Protocol version six (IPv6). The research outlines the initial intended useful life and limitations of IPv4 and IPv6. The financial aspects of transitioning to IPv6 are examined from a programs perspective, relative to the program objective memorandum (POM). Implementation of transition strategies and mechanisms are identified and courses of action for implementing the mandatory IPv6 requirement are recommended. The principal finding of this research is that DoD Global Information Grid (GIG) assets must function in a dual IPv4/IPv6 capacity when transitioning to IPv6 in order to maintain the relevance of currently fielded programs. Furthermore, legacy GIG assets should be transitioned using Technology Refresh or Software Block upgrade programs while paying careful attention to the effects the transition has on tactical network operations.

**KEYWORDS:** IPv4, IPv6, Global Information Grid Assets, GIG Assets, Legacy GIG Assets, Transition Strategies, Tactical Network Operations

# MASTER OF SCIENCE IN SPACE SYSTEMS OPERATIONS

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## ASSESSING THE POTENTIAL OF HYPERSPECTRAL IMAGERY TO DETECT AND MAP LYNGBYA SPP.: A BIOLOGICAL INDICATOR FOR PRESENCE OF METAL AND MAN- MADE OBJECTS IN THE LITTORAL ENVIRONMENT

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The aquatic filamentous bacteria (cyanobacterium) *Lyngbya majuscula* is a nitrogen-fixer found in coastal waters often attached or adjacent to sea grass, algae, and coral. It is characterized by phycobiliproteins, unique pigments found only in cyanobacteria. To sustain photosynthesis and nitrogen fixation, *L. majuscula* requires iron proteins and is therefore sensitive to the availability of this metal. The hypothesis tested in this study concerns the potential use of hyperspectral imaging in detecting *L. majuscula* in coastal regions as biological indicators for the presence of iron debris or metal objects in the littoral environment. This concept would have potential benefits and applications in mine detection and countermeasure techniques. Using a USB2000 field spectroradiometer, a spectral library is developed for the benthic substrates of Midway Atoll, Northwest Hawaiian Islands, spectrally characterizing *L. majuscula* and the surrounding coral reef substrates. The data is analyzed to determine unique spectral characteristics of the benthic cyanobacteria in a mixed coral environment, and also evaluated against the resampled spectral resolution of a number of hyperspectral sensors: Airborne Visible/Infrared Imaging Spectrometer (AVIRIS), Hyperspectral Mapper (HyMap), and Compact Airborne Spectrographic Imager (CASI). The results of the in situ spectroscopy suggest a strong potential for all three sensors to detect these cyanobacteria in a mixed coral reef environment at 4 distinct wavelengths attributable to phycobiliprotein pigment absorptions unique to cyanobacteria. Of these 4 discriminative absorption ranges, the phycoerythrin absorption of 565-576 nm shows the greatest potential for segregating cyanobacteria from a mixed algal/coral/sand environment, so long as the coral *Montipora* spp. is not present within the scene, since it has an overlapping absorption in those wavelengths. In the presence of *Montipora* corals, these cyanobacteria are more difficult to detect. However, in a mixed environment composed of *L. majuscula* and *Montipora* corals, the cyanobacteria can be distinguished by a different phycocyanin absorption, at 615-632 nm.

**KEYWORDS:** Hyperspectral, Cyanobacteria, Littoral, Metal Object Detection





# **MASTER OF SCIENCE IN SYSTEMS ENGINEERING**

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## **DIRECT ELECTRIC FIELD VISUALIZATION IN SEMICONDUCTOR PLANAR STRUCTURES**

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

A new technique for imaging the 2D transport of free charge in semiconductor structures is used to directly map electric field distributions in operating devices. Direct transport imaging is demonstrated in a scanning electron microscope, using an optical microscope and a high sensitivity charge coupled device. Transport behavior under the combined influence of both diffusion and drift is predicted by modeling the drift and diffusion in 2D following generation at a point source. This is the first demonstration of a technique that allows the mapping of the electric field by determining not only the direction but especially the magnitude of the electric field with high resolution. The measured results show excellent agreement with theoretical predictions simulated with COMSOL software.

The transport imaging technique also allows measurement of the contact resistance in a new way that is non-destructive and based on a two-point contact only. The technique illustrates the device's characteristics by determining the exact activation point of the diode and the deviations from an ideal I-V behavior. The method is extremely useful since the complexity and miniaturization of current devices do not allow for multiple wiring that standard four point measurement demands.

Finally, a suggestion for further research of the effects of electromigration by using the direct transport imaging technique is offered. The latter is a subject of high importance in electronic device reliability.

**KEYWORDS:** Diffusion, Direct Transport Imaging Technique, Drift, Electric Field Mapping, Minority Carrier Lifetime, Minority Carrier Mobility, Semiconductors

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## **SYSTEMS ENGINEERING**

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### **SYSTEMS ANALYSIS OF ALTERNATIVE ARCHITECTURES FOR RIVERINE WARFARE IN 2010**

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This thesis analyzes the Navy's proposed Riverine Force (RF) structure and capabilities of 2006. Systems Engineering and Analysis Cohort 10 (SEA10) developed a cost-effective system of systems that increases battlespace awareness and situational responsiveness for 2010. Riverine missions are decomposed into their functional, physical, and operational architectures using the detect-to-engage sequence. This analysis determines critical RF functions. Critical functions detect and engage are then physically represented by feasible force package alternatives that augment the baseline RF. SEA10 analyzes these alternatives using agent based models to identify baseline RF capability gaps. Insights into possible solutions are provided.

Reduction of modeling data indicates that the baseline force is as effective as some upgraded force packages, depending on the measure of performance (MOP) or scenario structure under scrutiny. Sensor augmentation demonstrates significant improvements to baseline performance by increasing battlespace awareness. Weapon augmentation alone does not significantly improve baseline performance by increasing situational responsiveness. Combined sensor-weapon augmentation performs well across all MOP and scenarios. The Unmanned Surface Vehicle (USV) is the most cost-effective alternative. Dedicated helicopter support demonstrates the best performance overall, but is the most costly alternative.

**KEYWORDS:** Riverine Force 2010, Riverine Cost Estimation, Riverine Detection Alternatives, Riverine Engagement Alternatives

### **DESIGN AND ANALYSIS OF SIDE-LOOKING SONAR EXPERIMENTS**

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This research concerns the design and analysis of different Side-Looking Sonar experiments in order to satisfy different operational requirements. The different designs and analysis are done via computer simulation. Side-Looking Sonar (also known as side-scan sonar) is known for very high quality, high resolution, ocean bottom imaging. Hence, it is used for bathymetric surveys, commonly called seafloor mapping. It is able to rapidly survey large ocean areas for bottom and suspended sea-mines or other kinds of threats. Another operational aspect of these systems is that they allow autonomous underwater vehicles

(AUVs) to conduct operations, mostly in shallow water and near land. Thus Side-Looking Sonar can be a very useful device in littoral warfare operations. This research defines the basic parameters that rule the operation of a Side-Looking Sonar and, furthermore, analyzes various aspects that affect the performance of these parameters. Special focus is given to the various operational requirements and conditions that a designer or a user may encounter in realistic situations. Toward that end, many numerical examples are presented. Moreover, this research tries to indicate the various problems that may arise when a Side-Looking Sonar operates in its near-field region and suggests certain solutions. The active sonar equation and its factors are also explained and evaluated for a realistic example of mine detection.

**KEYWORDS:** Side-Looking Sonar, Side-Scan Sonar, Ocean Bottom Imaging



# **MASTER OF ARTS**

**National Security Affairs  
Security Studies**



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

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## **AN EXAMINATION OF OVERT OFFENSIVE MILITARY OPERATIONS OUTSIDE OF COMBAT ZONES**

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

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Under the leadership of the United States Special Operations Command (USSOCOM), the military is undergoing transformation to more effectively counter the asymmetric threat of non-state terrorists and extremists in the “long war.” After five years, however, one component of national security strategy is visibly unfulfilled: military pursuit of terrorists and extremists outside of Afghanistan and Iraq. The lack of offensive military efforts outside of areas designated as combat zones creates the impression that the long war has stalled. Overt offensive military operations targeting non-state actors may advance the counter-terrorism mission and serve as a deterrent.

This thesis identifies and analyzes four major constraints on the conduct of such operations: legal concerns about the use of force, use of the Central Intelligence Agency (CIA) for covert paramilitary activities, limits on USSOCOM and Special Operations Forces, and civilian and military leaders' aversion to risk. This thesis describes the historical, bureaucratic and cultural causes of the constraints, concluding with recommendations to allow the U.S. government and the U.S. military to pursue non-state terrorists and extremists with overt offensive military operations.

**KEYWORDS:** Terrorism, United States Special Operations Command, Covert Operations, Central Intelligence Agency, Special Forces, Special Operations Forces, International Law, Risk Aversion, Non-state actors, Title 10, Title 50

## **VIOLENCE AND INSTITUTIONALIZATION IN ISLAMIC ACTIVISM: EXPLAINING MODERATION**

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Over the last few decades, a number of Islamist groups, some listed as terrorist, have increasingly participated in political elections and shown a pattern of moderation. What explains the move away from violence to achieve group goals? Analyzing three cases, Hizbullah in Lebanon, the Muslim Brotherhood in Egypt, and Hamas in the occupied Palestinian territories, this thesis examines the causes of moderation and willingness to participate in existing political structures. Using aspects of social movement theory, it is argued that institutionalization and interests of maintaining membership explain why, when political opportunities arise, Islamist groups take the democratic path and forego violence. The conclusions aid in promoting democracy in the region by demonstrating when Islamist groups are willing to participate in formal politics.



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## NATIONAL SECURITY AFFAIRS

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**KEYWORDS:** Hamas, Hizbullah, Islamic Activism, Islamist, Muslim Brotherhood, Social Movement, Theory

### **CUPS, COWBELLS, MEDALS, AND FLAGS: SPORT AND NATIONAL IDENTITY IN GERMANY, 1936–2006**

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The present study addresses the role of sport in the evolution of modern German nationalism. This work contains: a) an historical analysis of nationalism, culture, and sport from the late eighteenth until the mid-twentieth century, b) a case study of the 1936 Garmisch/Berlin Olympics as an example of virulent nationalism and racism, and c) a case study of the 2006 World Cup in Germany as an example of national identity in twenty-first century Germany in the wake of reunification and globalization. Sport has been central to how Germans see themselves from the end of the eighteenth century until the present.

This work argues that an analysis of sports, domestic politics, and diplomacy can offer those interested in nationalism in contemporary Europe a helpful means of analysis of a force that remains powerful, despite the construction of the European Union. While an analysis of the evolution of mass sport indicates that Germans no longer apply the kind of racist blood and soil nationalism so virulent in the early twentieth century, sport has shown a remarkable continuity as a mirror of German aspirations for their nation, which has changed fundamentally in the realms of culture, society, and economy in the twenty-first century.

**KEYWORDS:** Europe, Germany, Nationalism, National Identity, Sport, Olympic Games, World Cup, FIFA, National-Socialism, 1936 Berlin Olympics, 2006 World Cup, Patriotism, Third Reich, Reunification, European Union, Federal Republic of Germany, FRG, German Democratic Republic, GDR

### **THE IMPLEMENTATION OF SPECIAL AUTONOMY IN WEST PAPUA, INDONESIA: PROBLEMS AND RECOMMENDATIONS**

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West Papua in the easternmost area of Indonesia has long been recognized as one of its most controversial provinces. Since its integration into the Republic of Indonesia in 1969, recurring controversy has colored many aspects of West Papuans' everyday lives. The problems in West Papua are rooted in the way it was originally integrated, which, according to some scholars, is "unacceptable." They argue that the Indonesian government manipulated the self-determination process and its results. The government, however, has always denied this claim, noting in its legal argument, for instance, the involvement of the United Nations and the international community in the process of self-determination, known as "the Act of Free Choice." Far from being resolved, the problems in West Papua have been exacerbated by the Indonesian government's policies, which rely heavily on a strict security approach in an effort to suppress the secessionist movement.

As part of its attempt to comprehensively address the problems, the Indonesian government introduced a "special autonomy" bill for West Papua in early 2001. The bill, which was drafted mostly by indigenous West Papuans, passed the Indonesian parliament as Law No. 21 in November. Implementation of the law, however, has not worked as expected. Many of the law's requirements have either not been implemented or have been only minimally implemented, even five years after of the law's promulgation. As a result, many West Papuans, including many scholars, have become increasingly skeptical and cynical. Obviously, the Indonesian government must deal with and resolve the problems inherent in the implementation law's requirements. This thesis addresses some of those problems and provides recommendations for potential solutions.

**KEYWORDS:** West Papua, Indonesia, The Act of Free Choice, OPM, Special Autonomy, Implementation Problems

## **MILITARY INTERVENTION IN IDENTITY GROUP CONFLICTS: A SOCIAL MOVEMENT THEORY PERSPECTIVE ON THE SUNNI INSURGENCY IN IRAQ**

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This thesis investigates why Iraq's Sunnis resorted to violent collective action, rather than non-violent political action, following Saddam's overthrow. Using social movement theory, the author argues that decreasing political opportunity, existing mobilizing structures with violent repertoires, and effective framing of the opposition as kufr (non-Muslim) explain the emergence of Iraq's Sunni insurgency. The author posits that Sunnis felt a profound grievance in the decreased political opportunity following the overthrow of Saddam Hussein. Furthermore, mobilization nearly always utilizes existing networks and adapts the characteristics of the physical spaces and organizational structures from which the movement emerges. The author argues that the disbanded military and militant Islamist networks comprised the bulk of the first insurgent groups, and that these groups used their existing repertoires to shape Iraq's political environment. The author then traces the frames used throughout the conflict, illustrating that the common theme is opposition to rule by kufr – whether it be coalition nations or Iraqi Shi'a – and this provides a concrete target for the insurgency. Examined collectively, these three factors provide a sufficient explanation for the Sunni insurgents' turn to violence to address their political grievances. This argument stands in contrast to the clash of civilizations and "Cosmic War" arguments, which offer insufficient explanations.

**KEYWORDS:** Iraq, Saddam Hussein, Insurgency, Social Movement Theory, Sunni, Collective Identity, Political Opportunity, Mobilizing Structures, Framing

## **THE RESILIENCY OF TERRORIST HAVENS: A SOCIAL-MOBILIZATION THEORY APPROACH**

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Terrorist havens are an important policy problem today. The policy and academic literature has generally concluded that failed states are more likely to be terrorist havens, but some have begun to question this conventional wisdom. While the link between state failure and terrorist havens is fairly clear, it does not tell the entire story. This thesis borrows from an aspect of social mobilization theory to try to explain why some havens are more resilient to outside pressure than others. It argues that a shared collective identity between the group providing haven and the havened terrorist group makes the havening group less likely to buckle under outside pressure. To test this theory, the thesis compares the frames that define al Qaeda's collective identity with those of the Sudanese National Islamic Front and the Afghan Taliban to determine whether observed variations in haven resiliency can be explained by the levels of shared collective identities in each case. The findings suggest that the theory can account for the variation in resiliency, while raising new questions for future research.

**KEYWORDS:** Terror, Terrorist, Terrorism, Terrorist Havens, Sanctuary, Sudan, National Liberation Front, Afghanistan, Taliban, Taleban, al Qaeda, Osama bin Laden, Global War on Terrorism, Social Mobilization Theory, Failed States

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## NATIONAL SECURITY AFFAIRS

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### THE ROLE OF NATO AND THE EUROPEAN UNION (EU) IN RESOLVING FROZEN CONFLICTS

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A number of unresolved conflicts and unrecognized states lie on Europe's periphery, most of which emerged during the dissolution of the Soviet Union. Due to their remote and strategically insignificant nature, they were largely ignored by the West as it peacefully integrated Central and Eastern Europe into the community of liberal democracies. Russia utilized the lack of international concern to prolong the conflicts in Abkhazia, South Ossetia, Transnistria, and Nagorno-Karabakh, and to destabilize the smaller states emerging from the Soviet Union. In 1974, Turkey acted in a similar manner in Northern Cyprus. The conflicts exploit a fundamental ambiguity in international law between sovereignty and self-determination.

This study shows that NATO and the European Union (EU) have the ability to resolve frozen conflicts through their influence on the third parties that are preserving them. Unlike earlier solutions made only by one or two great powers, NATO and the EU represent the majority of established democracies in the world. As they share common values, they can reach consensus on policy actions, unlike the UN or the Organization for Security and Cooperation in Europe (OSCE). As large organizations of democratic states, they possess creditability that no other institution or great power combination has ever had before. They also have the military capability to support policy choices. Furthermore, Russia and Turkey have a record of submitting to well-coordinated Western policy and exploiting differences in it if such coordination is lacking.

**KEYWORDS:** Frozen Conflict, Russia, NATO, EU, Abkhazia, South Ossetia, Transnistria, Nagorno-Karabakh, Northern Cyprus, Kosovo, Chechnya

### A CONCISE ANALYSIS OF ARGENTINA'S POST-JUNTA REFORM OF ITS MAJOR SECURITY SERVICES

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For newly formed democracies, security-sector reform is essential and plays a crucial role in their long-term governmental and institutional stability. The implementation of appropriate security-sector reform by transitional governments in areas of regional instability, such as Iraq, Argentina, and El Salvador, is an issue of considerable concern, not only for the countries themselves, but also for their neighbors and the world at large. Such civil-military reforms provide newly elected civilian governments stability, peace of mind, and a monopoly on the use of armed force to ensure the safety of national borders, sovereignty, and public safety. The purpose of this thesis is to define and explore the successes and failures of the Argentine reforms under the new, democratically elected civilian government vis-à-vis security services' overall performance. It examines the overall effectiveness of the security services under these reforms by breaking down the successes and failures across the police, military, and Gendarmerie forces. This thesis focuses on Argentina's reform of its three major security services following the collapse of the military junta in 1983. The successes and failures of Argentina's reforms are also analyzed by examining the overall performance of the security services and their effectiveness under the new reforms.

**KEYWORDS:** Argentina, Civil Military Reform, Buenos Aires Provincial Police, Police Reform, Gendarmerie

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# NATIONAL SECURITY AFFAIRS

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## **THE DEPARTMENT OF DEFENSE'S (DOD) USE OF IRAQI EXILES**

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The U.S. government has utilized exiles for decades, the latest example being the use of Iraqi exiles starting after the Gulf War. For close to thirteen years America supported opposition groups, overtly after the signing of the Iraq Liberation Act of 1998. The Department of Defense's (DoD) role until months before the invasion of Iraq was minimal, but then increased dramatically. Iraqi opposition groups provided names of volunteers willing to work with the U.S. military. Most were turned away for a number of reasons, but those selected were trained in civil affairs operations and embedded with great success in small teams into U.S. civil affairs units.

Another program, even more ad hoc, involved Ahmad Chalabi's fighting forces. Not receiving the welcome from Iraqis that intelligence experts told them to expect, U.S. military commanders were eager to put an "Iraqi face" on operations and build the core of the new Iraqi army. Chalabi's fighters, escorted by U.S. Army Special Forces A-Teams, provided a number of useful services to the war effort, but with minimal logistical support and hindered by Chalabi's political ambitions, they were quickly disbanded.

Exiles have many of the skills necessary in conventional and asymmetric warfare: language skills, familial ties, and cultural proficiency. But this unique segment of society needs to be better utilized by the DoD. After analyzing each of the Iraqi exile programs in detail, suggestions on how to harness needed skills in the future are offered.

**KEYWORDS:** Ahmad Chalabi, Army Special Forces, Civil Affairs, Counterinsurgency, Diaspora, Exiles, Free Iraqi Forces, FIF, Free Iraqi Fighting Force, FIFF, Iraq Liberation Act of 1998, Iraqi Opposition Groups, Operation Iraqi Freedom

## **THE DILEMMAS OF DEVELOPING AN INDIGENOUS ADVANCED ARMS INDUSTRY FOR DEVELOPING COUNTRIES: THE CASE OF INDIA AND CHINA**

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This thesis investigates the feasibility of developing nations' ability to create a wholly indigenous, advanced arms industry in the twenty-first century. China and India are used as case studies. The author proposes that it is not possible for developing nations in the current context of the globalized arms race to build an advanced arms industry because of the high political and economic costs. Diverse competing interests force politicians to make decisions about distribution and usage of resources that will maintain their legitimacy. The hypothesis does not rule out that some domestic advancements may be made in certain sectors, such as nuclear bombs and missiles, because resources may be spent on narrowly defined goals instead of the development of the whole industry. Nor does it rule out that a developing nation cannot have a modern military with advanced weaponry, just that the weapons will not all be wholly domestic. They will obtain advanced weapons through joint development, purchasing, or licensing. Political and economic costs will explain the failure of a wholly indigenous advanced arms industry to fully develop. The few successes within certain sectors of the industry are illustrated.

**KEYWORDS:** China, India, Defense Industry, Arms Industry, Indigenous, Domestic, Modernization, Developing Nations, Less Than Developed Nation, South Asia, Development, Political Will, Political Capital, Fighter, Aviation, Nuclear Weapons, Missiles

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## NATIONAL SECURITY AFFAIRS

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### THE U.S. STRATEGIC FLEXIBILITY POLICY: PROSPECTS FOR THE U.S.-REPUBLIC OF KOREAN ALLIANCE

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The U.S.-Republic of Korean (ROK) alliance has been a vital element for South Korea's security since the end of the Korean War. By successfully serving its primary role in deterring a North Korean reinvasion of the South, the U.S. Forces in Korea (USFK) was the core within the alliance. Since the September 11, 2001, terrorist attacks on the United States, it began to transform the structure of U.S. forces overseas under the Military Transformation plan. In this context, the USFK is undergoing an unprecedented transformation process. With the United States and South Korea's recent agreement on the strategic flexibility of USFK, it became obvious that the primary role of the USFK will be changed from North Korean deterrence to a regional contingency force. This thesis assesses the implications of the U.S. strategic flexibility policy for South Korean security. It discusses how the U.S. strategic flexibility will influence the security circumstances surrounding the Korean peninsula and how it could change the U.S.-ROK alliance. The U.S.-Japan alliance transformation and the realignment of USFJ is assessed as a case study. Finally, based on the four criteria that are determined to be essential elements in South Korean security, South Korea's policy options toward the U.S. strategic flexibility policy are assessed.

**KEYWORDS:** U.S. Strategic Flexibility Policy, U.S.-ROK Alliance, USFK, U.S.-Japan Alliance, USFJ, Regional Alliance, Korean Peninsula, South Korea, North Korea, Self-Reliant Defense, Force Realignment, Alliance Transformation, South Korea's Relationship with China and Japan

### DEMOCRACY: A TREE WITHOUT ROOTS ON THE STEPPES OF CENTRAL ASIA

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This thesis combines transitology and structural analyses to examine the obstacles to democracy in Kyrgyzstan and Uzbekistan. The transitology approach analyzes the impact of domestic political factors (clan politics, corruption, and political Islam) and external influences on each country's transition to post-Communist rule. The structural analysis focuses on those economic and societal factors that impact the country's ability to foster and sustain democratic reforms. For both countries, the complex interplay of clan politics and rampant corruption is the dominant factor in stifling democratic reforms. External influences were important in the case of Kyrgyzstan, though not determining, but were basically inconsequential in Uzbekistan. In each country, economic underdevelopment has stifled the emergence of a large middle class and served as a catalyst for societal dissatisfaction. The United States must continue to assist Kyrgyzstan in completing its economic reform agenda and play a greater role in helping guide amendments to the constitution. In Uzbekistan, the United States must rely on economic reform incentives tied to concrete milestones and look to engage the next generation of leaders with targeted assistance to achieve political and economic reforms.

**KEYWORDS:** Central Asia, Kyrgyzstan, Uzbekistan, Democracy, U.S. Policy, Bush Doctrine, Clan Politics

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# NATIONAL SECURITY AFFAIRS

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## UNLOCKING INDIAN MARITIME STRATEGY

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The Indian Navy has undergone several periods of expansion in its short history, which have signaled significant change in the Indian Ocean region. The region is currently undergoing another change. This thesis examines the current expansion of the Indian Navy's maritime strategy. The thesis focuses on three elements critical to all strategy, but which especially explain the expansion of maritime strategy. These three elements are national interests, perceived threats, and naval capabilities. An expansion in any of the three elements usually signals the expansion of its overall maritime strategy. This thesis reveals that there has been an increase in all three elements, which forecasts an immense increase in India's overall maritime strategy and further naval expansion.

**KEYWORDS:** Indian Maritime Strategy, Indian Navy, India, South Asia, Naval Strategy, Indian Ocean

## FRENCH NUCLEAR STRATEGY IN AN AGE OF TERRORISM

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This study treats the character of French nuclear policy since 11 September 2001; as such, this work adds the most recent episode to a theme that, since the late-1950s, has concerned alliance statecraft faced with French exceptionalism in trans-Atlantic relations. In the post-Cold War era, the changes in strategic environment have led to an evolution in French nuclear deterrent policy.

In 2001 and 2006, French President Chirac made speeches that specifically discussed nuclear strategy and clarified the shift in French thought and the justification for deterrence. In 2001, the most important element addressed *dissuasion* of regional powers and "rogue" states with weapons of mass destruction (WMD) that may attack France. The 2006 speech incorporated the threat of state-sponsored terrorism into the nuclear dissuasion strategy.

This thesis investigates past and present developments in French nuclear strategy, from the end of the Cold War to the beginning of the 21st century; it highlights the forces that have shaped French doctrine and analyzes the viability of their nuclear strategy. A review of French Cold War doctrine provides the necessary backdrop for an evaluation of new elements in French nuclear strategy and should act as a guide to students of same in U.S. and NATO policy circles.

**KEYWORDS:** French Nuclear Strategy, Deterrence, Dissuasion, Nuclear Doctrine, France, European Nuclear Deterrence, Franco-American Relations, Regional Security, Proliferation, Weapons of Mass Destruction, Force de Frappe, Nuclear Tagging, Preventive War, Regime Change

## JOINT STRIKE FIGHTER ACROSS THE ATLANTIC: TO UNIFY OR DIVIDE?

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This thesis examines the procurement of fighter aircraft as an indication of transatlantic relations. Specifically, it asks if European rationale toward purchasing the Joint Strike Fighter (JSF) indicates its position toward increasing military capabilities and the importance placed on defense cooperation with the United States. Certain observers have suggested that the relentless U.S. pursuit of technology in the

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“Revolution in Military Affairs” has exacerbated the capabilities gap and encouraged the U.S. to act unilaterally. This thesis argues that the JSF offers allies a means to circumvent recent damage done in the Atlantic Alliance. Through a case study of four countries “expected” to purchase the JSF to replace U.S.-made F-16 aircraft, this thesis concludes that rationale for some who have heretofore abstained from the program is worrisome, but the fact that some are electing to pursue other choices indicates further divergences in the transatlantic realm. Through the views of these countries and looking at the larger picture, the JSF will further divide Europe and the U.S. in defense relations, as the pursuit of military technology threatens to drive the U.S. away from multilateralism and toward a “buy our equipment or be left out” stance on the so-called network-centric battlefield.

**KEYWORDS:** Joint Strike Fighter, Transatlantic Relations, Capabilities Gap, Interoperability, NATO

### **JAPAN AS A PARADIGM FOR U.S. HOMELAND SECURITY**

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The 9/11 terrorist attacks on the United States were the impetus for change within the U.S. homeland security establishment. Despite these changes, deficiencies still exist. In addition to these deficiencies, the Global War on Terrorism (GWOT) is in full swing and the United States is engaged around the world. These factors provide valid reasons for the United States to research other countries’ homeland security paradigms to provide a contrast in methods of combating terrorism. This thesis investigates the 9/11 terrorist attacks and the U.S. reactions in response to these attacks. As a country that has combated terrorism in the past, Japan’s experiences with the Japanese Red Army (JRA) and Aum Shinrikyo, indigenous terrorist groups, are elucidated. The U.S. responses to 9/11 are compared to Japan’s responses to the JRA, Aum Shinrikyo, and 9/11. These comparisons are analyzed and used to describe the Japanese homeland security paradigm. This paradigm is applied to the U.S. strategy to combat terrorism to identify aspects of U.S. strategy that should be improved by implementing the Japanese homeland security paradigm. This thesis is written in the hope that the United States can learn from another country’s successes and failures in combating terrorism.

**KEYWORDS:** Japan, Homeland Security, Terrorism, Global War on Terrorism, Japanese Red Army, Aum Shinrikyo, 9/11

### **THE RISE OF PAN-ISLAMISM IN BRITAIN**

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Terrorist events in Britain in recent years indicate that some British Muslims do not view their lives through a domestic lens; that is, they do not embrace British norms and values. Instead, they identify with a global Muslim community in a radical way. This thesis explains what is fueling the rise of pan-Islamism in Britain.

For many Muslims, their religious identity is stronger than their British identity because they are alienated from the rest of society. The alienation is generated by poor socioeconomic conditions and discrimination, racism, and Islamophobia. The most important source of alienation, however, is the perception that British foreign policy in Muslim lands is leading to oppression and killing of their Muslim brothers and sisters. Alienation would not necessarily translate into mobilization and action were it not for radical leaders of the domestic Islamist community who were able to exploit protections provided by liberal British laws and traditions. These men inspired the alienated to adopt their pan-Islamist ideology.

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## NATIONAL SECURITY AFFAIRS

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**KEYWORDS:** Islamism, Alienation, London Bombings, British Foreign Policy, Londonistan, Islamophobia, Multiculturalism, British Muslim, Anti-Terrorism Legislation

### **CONSTRUCTING A REGIONAL ORDER: NORTHEAST ASIA AND THE SYSTEMIC CONSTRAINTS ON KOREAN UNIFICATION**

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Nowhere has the mid-20th century polarization of Northeast Asia been more evident than on the Korean Peninsula. Over the past six decades, efforts toward Korean unification have spanned the range of total warfare, covert attacks, propagandist affronts, and formal diplomacy to no avail. Amidst the talk of unification, however, it seems a better understanding about the evolving nature of Korea's division is needed. Using a truly unique international relations (IR) approach, this thesis explores the utility of Alexander Wendt's Social Theory of International Politics to address the evolving structure of Northeast Asia and its implications for Korean unification. The results of this analysis contrast with those of predominant IR theories, such as Neorealism, and suggest that unification is becoming less likely under current structural trends. Additionally, the constructivist methodology employed here shows that while the United States will continue to play an important role in regional security, it must begin to diverge from its anachronistic Cold War defense posture to ensure future stability. By providing a deeper understanding about the macro-level structure of Northeast Asia, this thesis contributes to the development of policies that will both enhance regional stability and aid in the eventual unification of the two Koreas.

**KEYWORDS:** International Relations, Constructivism, Social Theory of International Politics, STIP, Korea, Unification, Reunification, Divided States, United States Foreign Policy, Northeast Asia, Cold War

### **THE BALANCER POLICY REVIEWED FROM THE PERSPECTIVE OF THE REPUBLIC OF KOREA (ROK)-U.S. ALLIANCE: TOWARD A MATURE ROK-U.S. ALLIANCE**

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This thesis examines the viability of the South Korean balancer policy in terms of the ROK-U.S. alliance, and suggests directions in which the alliance should proceed. The balancer policy announced by President Roh in March 2005 implies that, if it is adopted, South Korea will play the role of a balancer between the regional powers in Northeast Asia. The so-called balancer policy has been a source of controversy since its announcement, as the pros and cons of South Korea's balancer role have been debated both at home and abroad. The balancer policy announced by the President as a national foreign strategy is worth consideration because it has provided South Korea with an opportunity to think about its future foreign policies in terms of the ROK-U.S. alliance. Considering that the ROK-U.S. alliance has been a linchpin of South Korean foreign policy for the last half century and that the alliance has not only deterred North Korean aggression but has also helped create a stable environment for economic development and democratic consolidation in South Korea, it is clear that any policy options which may deteriorate the ROK-U.S. alliance should be avoided. Whatever policy option that is adopted should contribute to the strengthening of the ROK-U.S. alliance by overcoming currently emerging frictions and mistrust between the two countries.

**KEYWORDS:** The Balancer Policy, The ROK-U.S. Alliance, Northeast Asia, Strategic Environment





# **MASTER OF ARTS IN SECURITY STUDIES**

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## **U.S. BIODEFENSE AND HOMELAND SECURITY: TOWARD DETECTION AND ATTRIBUTION**

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American leaders face tough decisions about the role of biodefense in homeland security. Debate centers on U.S. preparedness for biological attack, but few, if any, have adequately defined “preparedness.” This thesis defines bioterrorism preparedness in terms of detection and attribution. Through case studies of the 1984 Rajneeshee cult and 2001 U.S. anthrax attacks, this thesis develops a notional model of biodefense that shows that the nature of attack and the lethality or type of agent influence outbreak detection and biological weapons attribution. Because public health surveillance facilitates detection and interagency coordination facilitates attribution, there is a need to re-balance U.S. biodefense priorities by easing emphasis on current programs and redirecting resources to simpler improvements in communication and organizational efficiency. Core limitations of the public health system that impede surveillance are discussed, and barriers between public health and law enforcement officials that hamper coordination are examined. Recommendations are provided to improve detection through better surveillance, and to enable attribution through better coordination and information sharing.

**KEYWORDS:** Biodefense, Bioterrorism, Biological Attack, Disease Outbreak Surveillance, Epidemiology, Detection, Attribution, Public Health, Forensic Epidemiology

## **CONSTITUENCY CONSTRAINTS ON VIOLENCE: AL-QAEDA AND WEAPONS OF MASS DESTRUCTION (WMD)**

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The changing nature of terrorist attacks in the previous decade has cast doubt on the commonly accepted constraints on terrorist violence. Claims that these constraints are eroding has led to an unstudied assumption that modern terrorist groups, and al-Qaeda in particular, are not subject to constituency constraints. Most alarming is the possibility that al-Qaeda, allegedly unconcerned with alienating supporters, will attack the United States with weapons of mass destruction (WMD). Yet no detailed study of al-Qaeda’s constituency constraints has been undertaken, even though they devote considerable effort to win popular support among Muslims.

This thesis reveals that al-Qaeda seeks the support of a constituency as the central pillar of their strategy. This constituency, contrary to Western portrayals, largely does not support indiscriminate killing and would not support a WMD attack. Al-Qaeda is aware of this sentiment, and as a pragmatic group is willing to alter their methods to gain supporters. Consequently, al-Qaeda is not likely to conduct such an attack for fear of alienating this constituency.

**KEYWORDS:** Terrorism, Al-Qaeda, Weapons of Mass Destruction

### **APPLICABILITY OF UNMANNED AERIAL SYSTEMS TO HOMELAND DEFENSE MISSIONS**

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Battlefield success of unmanned, aerial systems (UASs) prompted Department of Defense and Department of Homeland Security leaders to examine their possible applicability to homeland defense missions within the national strategy for homeland security. The national strategy for homeland security incorporates all levels of government, including law enforcement agencies and the military, the predominant owner and operator of UASs. The military, however, is restricted in its domestic role by the Posse Comitatus Act, and is therefore limited in its domestic employment of UASs. In order to determine the applicability of UASs to homeland-defense missions, it is necessary to examine the capabilities of available UASs, to match them with mission requirements, and to determine the legality of where they can be used and who can operate them. A policy that places combat-UAS capability with Title 10 military forces and homeland-defense mission capability with Title 32 and law-enforcement agencies will fulfill the goals stated in the national strategy and function within the current legal framework.

**KEYWORDS:** Unmanned Aerial Vehicle, Unmanned Aerial System, UAV, UAS, Homeland Defense, Homeland Security, 9/11, Terrorism, Intelligence Surveillance and Reconnaissance, ISR, Global War on Terror

### **AIR-BASE DEFENSE: DIFFERENT TIMES CALL FOR DIFFERENT METHODS**

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As the United States Air Force's air-base-defense doctrine evolved over the years, implementation and execution errors were occasionally exploited by insurgent forces operating in the areas adjacent to U.S.-occupied air bases. Executing unconventional attack methodologies, primarily via standoff weapons, these insurgents were able to wreak havoc on U.S. and allied air bases, causing massive destruction and loss of American life.

An examination of the literature from air-base (ground) attacks in Korea, Vietnam, and at Khobar Towers indicates several problematic areas resonating in all three cases. These common areas include inadequate intelligence (both organic and external), lack of proper focus on critical infrastructure, and insufficient or absent force-protection technologies.

Many security experts are predicting future attacks on military infrastructure, including stateside and forward-deployed air bases. Today's slightly diverse, yet consistent insurgent enemy, with attack methodologies mirroring those of Korea, Vietnam, and Khobar Towers, remains a constant and formidable threat.

As the Air Force moves forward with its newly implemented integrated base-defense doctrine, specific attention must be paid to improving upon problems from the past. This thesis focuses on specific problematical areas and provides policy recommendations for force-protection planners.

**KEYWORDS:** Air Base Defense, ABD, Integrated Base Defense, IBD, Critical Infrastructure Protection, CIP, Intelligence, Technology, Korea, Vietnam, Khobar Towers, Air Police, Security Police, Security Forces, Antiterrorism/Force Protection

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## SECURITY STUDIES

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### **THE USE OF AIR POWER FOR MARITIME HOMELAND DEFENSE**

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This thesis uses a capabilities-based methodology to determine what gaps exist in the military's current ability to perform maritime homeland defense against unconventional and asymmetric opponents. This approach reveals that including joint air assets as part of the maritime-defense force can significantly enhance protection of the homeland. In the short term, the military can use air power from each of the services for long-range maritime surveillance and interdiction. Additionally, using aircraft for maritime defense combat air patrol provides an effective and efficient last line of defense. Over the longer term, an investment in new technologies, including non-lethal weapons and persistent surveillance platforms, can make the joint force an even more effective guarantor of U.S. maritime security.

**KEYWORDS:** Maritime Defense, Homeland Defense, Maritime Security, Air Power, Capabilities-Based Planning, Non-Lethal Weapons

### **POLICING TOWARD A DE-CLAWED JIHAD: ANTITERRORISM INTELLIGENCE TECHNIQUES FOR LAW ENFORCEMENT**

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This thesis examines intelligence strategies that law enforcement officials may use to combat transnational Islamic terrorism in the United States. Many of the concepts discussed in this thesis come from U.S. intelligence community approaches. Others are familiar to both intelligence and law enforcement professionals. The thesis focuses on Islamic terrorism, most notably promoted and conducted by al-Qa'eda, though a number of the techniques can apply to other terrorist threats. The religious foundations of Islamic terrorism and the milieu in which it flourishes provide both a strategic and tactical backdrop for what has been cast as a global jihad—a violent, worldwide religious campaign with political objectives. The unique ethnic and religious characteristics also present specific challenges for law enforcement intelligence operations, most notably in collecting human intelligence. Processing collected threat intelligence and developing defensive plans require a broad, multi-layered strategy to be successful in meeting the challenges posed by a geographically pervasive terrorist threat. As this thesis argues, local jurisdictions must work in tandem with national-level organs to create an effective system that will identify and prevent potential terrorist operations in the United States.

**KEYWORDS:** Terrorism, Antiterrorism, Counterterrorism, Anti-Terrorism, Counter-Terrorism, Law Enforcement, Police, Intelligence, Human Intelligence, HUMINT, Source, Intelligence Analysis, Risk Assessment, Islamism, Islamist Terrorism, Islamic Fundamentalism, Transnational Terrorism, Salafism, Salafi, Salafist, Jihad, Global Jihad, Global Salafi Jihad, Terrorist Network, Network

### **THE EUROPEAN UNION COUNTER-TERRORISM STRATEGY: ORIGINS, PROBLEMS, AND PROSPECTS**

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The European Union (EU) published its first Counter-Terrorism Strategy in December 2005. After four years of reacting to the major terrorist attacks in the United States in 2001, Madrid in 2004, and London in 2005, the EU has enacted a substantial body of counter-terrorism measures across multiple functional areas. The implementation of these actions, however, has not always been consistent or timely, due to a number of issues, including public threat perception, concern over social tensions, and competing national priorities. These roadblocks to a successful counter-terrorism policy were often discovered upon new terrorist attacks and a renewed evaluation of EU counter-terrorist activity. After the London bombings, the United Kingdom held the EU Presidency and immediately set to work on a strategy to counter terrorism, both similar and subordinate to the 2003 European Security Strategy, which specifically listed terrorism and weapons of mass destruction among the top five threats to the EU. The new strategy of 2005 outlines EU efforts over the long term and provides a tool for public information. Despite the EU's embrace of its new strategy, the document has many shortcomings. Evaluation of this strategy against a series of counter-terrorism best practices (accumulated from the work of functional and scholarly experts) shows several areas in which the effectiveness of this strategy to successfully affect terrorism is severely limited. In all, the European Union Counter-Terrorism Strategy serves limited use as a strategy document, but does serve to guide the EU's efforts in fighting terrorism, as well as deepen EU integration in security affairs, justice, and law enforcement.

**KEYWORDS:** European Union, Terrorism, Counterterrorism, Combating Terrorism, Strategy, Implementation, EU Integration, Threat Perception, Security Affairs

### **PREPARED FOR DISASTER? IMPROVING THE DEPARTMENT OF DEFENSE'S IMMEDIATE RESPONSE AUTHORITY**

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This thesis examines one of the Department of Defense's current provisions for providing immediate disaster response and assistance—the DoD's Immediate Response Authority (IRA). This thesis evaluates the IRA provision's role and capability to provide disaster assistance when first responders are wiped out or otherwise incapable of providing effective initial disaster response. Most would agree a "smarter" DoD role is more valuable than a larger one. This thesis explores various means to make the IRA provision "smarter" to help maximize resources and improve immediate military disaster response and assistance. This thesis also strives to determine where the DoD's IRA provision fits in relation to other federal and military response mechanisms and established national strategy and policy. The research identifies current barriers to the IRA provision's effectiveness, such as strategic guidance, oversight, and training, and also provides recommendations to help eliminate these barriers to eventually improve the overall effectiveness of this valuable resource for city, state, and federal first responders.

**KEYWORDS:** Homeland Security, Homeland Defense, Defense Support to Civil Authorities, Immediate Response Authority

### **QUANTITATIVE RISK ANALYSIS FOR HOMELAND SECURITY RESOURCE ALLOCATION**

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Defense against terrorism, both at home and abroad, has become a priority in the United States. As a result, resource allocation has also increased. However, even as resources increase, they are still finite. So the dilemma becomes how to efficiently allocate these limited resources? Currently, the data, while abundant, is confusing. One suggested method is to allocate resources based on risk. However, there is virtually no guidance on how that risk should be defined or what the parameters are in a risk-based approach. Also, there is no flow of information model that outlines how to communicate to decision makers the risk reduction potential of each policy alternative.

This thesis investigates the usefulness of quantitative risk analysis as an approach to determine the allocation of counter-terrorism resources. This approach develops a simulation-based quantitative risk assessment method that allows for subjective elements and uncertainties. The risk assessment information is then integrated with the cost of the alternatives to yield a risk-reduction-cost-tradeoff curve that guides decision makers with resource allocation decisions. This approach is demonstrated using the Port Security Grant Program as an example. It is found that the approach provides the decision maker with information required to discover robust resource allocation solutions.

**KEYWORDS:** Homeland Security, Quantitative Risk Analysis, Risk Management, Resource Allocation, Maritime Security, Port Security

### **A BALANCING ACT: ANTI-TERROR FINANCING GUIDELINES AND THEIR EFFECTS ON ISLAMIC CHARITIES**

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Although anti-terror financing efforts have yielded positive results, national and international guidelines that are in place to stem the flow of funds can have unintended consequences on legitimate business, charitable organizations, and communities in general. Specifically, for Islamic charitable organizations, the negative effects are particularly bad because charities are often created and operate in areas that support communities both affected by and interconnected with conflict. Islamic charities have drawn scrutiny after the attacks on September 11, 2001, and their ability to operate in the United States and elsewhere has run into roadblocks associated with anti-terror financing regulations. Several countries, including the United States, have started to regulate and monitor these organizations in an effort to stem the flow of funds to terrorist organizations. Yet, the policies can have an overall negative effect on the capability of these organizations to operate in the perceived constrained environment because of donor fear of being associated with Islamic charities, fear that donations will be misused, and/or fear from government retribution. This thesis explores the trade-offs involved in shutting off funding to Islamic charities and determines whether a balance can be struck between the policies and charities.

**KEYWORDS:** Anti-Terrorist Financing, ATF, Islamic Charities, Wahhabism, Madrassahs, Regulatory Regimes, United States, United Kingdom, Russia, Saudi Arabia, Sudan

### **AN END TO THE TROUBLES: UNIONISM, NATIONALISM, AND THE PATH TO PEACE**

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Understanding the roles played by the constituents to the Northern Ireland conflict is important and relevant for three reasons. First, an analysis of the factors contributing to a cessation of hostilities in Northern Ireland provides vital insights into the manner in which armed insurrections can be brought to an end. Second, the Northern Ireland experience provides a roadmap for the U.S. and others finding themselves involved in the quagmire of sectarian conflict. The Ulster experience can provide valuable lessons learned in the process of forming governments representative of all major elements of indigenous proportions in places like Afghanistan and Iraq. As such, a study of past attempts by a liberal democratic government to create a representative power-sharing government that crosses the sectarian divide is particularly apt. Finally, the success of the Good Friday Agreement (GFA) seems predicated on the acceptance of democratic principles by the IRA via its political wing, Sinn Fein, and the acquiescence of the Unionist population to a power-sharing arrangement, which includes representation from the Republican constituency. Neither position appears to have been sufficiently present in previous attempts at power-sharing. While the long-term viability of power-sharing in the province remains in question, a return to violence has not occurred. Ascription to democratic principles by erstwhile terrorists and acquiescence to power-sharing by the majority may be critical elements in bridging the sectarian divide, not only within the context of Northern Ireland, but when resolving terrorist/insurgent campaigns throughout the world.

**KEYWORDS:** Northern Ireland, Terrorism, Negotiated Settlement, Sunningdale Agreement, Anglo-Irish Agreement, Good Friday Agreement, Ulster Unionist Party, Democratic Unionist Party, Social Democratic and Labour Party, Sinn Fein, Unionist, Loyalist, Nationalist, Republican

### **THE BIOTERRORISM THREAT BY NON-STATE ACTORS: HYPE OR HORROR?**

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This thesis provides a capabilities-based approach to assessing the bioterrorism threat from non-state actors. Through comparative case study, prior bioterrorism attacks are analyzed to assess capability in the three areas necessary to complete a biological weapons attack: obtaining or isolating a pathogen, weaponizing the agent, and employing or disseminating the weapon. The three cases are the Rajneeshee cult in 1984, the Aum Shinrikyo cult in the early 1990s, and the United States Postal System anthrax attacks of 2001. In contrast to current wisdom that employing biological weapons is too difficult for non-state actors, this thesis reveals a broad spectrum of capability in all studies in the areas necessary to culminate an attack. Application of these findings must be used to assess risk generally, rather than against specific groups, because capability is deemed to be extremely difficult to track. The thesis finds that a significant threat exists but not large enough to be over-hyped above other national security concerns. In light of this, recommendations are provided for U.S. biodefense policy emphasis in the areas of the nonproliferation regime, attribution capabilities, and defending against the changing nature of future attacks with particular emphasis on the public health system.

**KEYWORDS:** Biological Terrorism, Biological Weapons, Biological Warfare, Threat Assessment, Risk, Rajneeshee Cult, Aum Shinrikyo Cult, USPS Anthrax Attacks 2001, Salmonella, Botulinum Toxin, Anthrax

### **THE MILITARY AND DOMESTIC DISASTER RESPONSE: LEAD ROLE REVEALED THROUGH THE EYE OF HURRICANE KATRINA?**

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The traditional role of the active-duty military force at home is one of support to a civilian Lead Federal Agency (LFA) that primarily falls under the Department of Homeland Security (DHS). During emergencies, military domestic assistance is historically provided when local, state, and federal resources have been overwhelmed. During and in the aftermath of Hurricane Katrina, however, the slow and perceived inept response to the massive disaster prompted a national debate on the appropriate role of the military in major domestic disasters. Many concerned with the federal response to Katrina believed that America's homeland security system could not aptly respond to a large-scale natural or man-made catastrophe without the military in a lead role. Defining the roles and understanding the responsibilities of the Department of Defense (DoD) within the National Response Plan (NRP) is an important first step toward an effectively coordinated federal disaster response.

The purpose of this research is to explore the role of the active-duty military in domestic disaster response, using Hurricane Katrina, to determine if the DoD and DHS response was implemented according to the NRP. This research will help to explain the role that the military plays in supporting the civilian LFA in disaster response.

**KEYWORDS:** National Response Plan, Domestic Disaster Response, Defense Support of Civil Authorities, Military Lead Role, Federal Response to Hurricane Katrina, DoD Disaster Response, Katrina Timeline

### **THE CONSTRAINING DYNAMICS OF PUBLIC OPINION**

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Since the beginning of the Cold War, the influence of public opinion on Presidential decision-making has been debated. Because the United States is a democracy, one would expect that public opinion and the ideas and concerns of the people should weigh on the decisions of the policy makers. In theory, at least, Presidential decision-makers should not solely determine policy. Yet most presidential administrations would have the public believe that they are leading, not following, public opinion based on their inherent charge as elected officials to advocate what they perceive to be in the best interest of the country. It is important to understand the relationship between public opinion and executive decision-makers.

Comparing U.S. policies implemented in response to terrorist attacks against U.S. sovereignty and Iraq's persistent pursuit of weapons of mass destruction (WMD) by presidents from two different political parties offers an opportunity to analyze how public opinion is viewed by presidents, what actions the administrations took to influence public opinion, and whether public opinion ultimately affected the foreign policy decision-making of the executive. How and when public opinion constrains policymakers and their options is essential to understanding why certain policy decisions for the use of force are made and what decisions can be predicted in the future.

**KEYWORDS:** Public Opinion, President Bill Clinton, President George Bush, Embassy Bombings, Iraq, WMD, 9/11, Foyle, Sobel





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