Compilation of

THESIS ABSTRACTS

March 2012

Office of the Vice President and Dean of Research
Naval Postgraduate School
PREFACE

This publication contains abstracts of unrestricted theses submitted for the degrees doctor of philosophy, master of business administration, master of science, and master of arts for the March 2012 graduation.

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.

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INTRODUCTION

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

Increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the 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) research programs that focus on the integration of education and research in support of current and emerging national security technologies and operations, and of

*Integrated • Systems Oriented • Flexible • Partnered for Strength*

*Four Institutes*
- The Cebrowski Institute for Information Innovation and Superiority
- The MOVES Institute (Modeling, virtual environments, and simulation)
- The Meyer Institute (National-security systems and technology)
- The National Security Institute (Partnership for security research and education)

*Four Schools*
- Graduate School of Engineering and Applied Science
- Graduate School of Operational and Information Sciences
- Graduate School of Business and Public Policy
- School of International Graduate Studies

Institutes ensure that the education imparted by the schools is applied to military challenges.
education and research in support of current and emerging national security technologies and operations, and 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer’s career. Programs of graduate studies at NPS are grouped as follows:

**Graduate School of Operational and Information Sciences**
- Computer Science
- Computer Technology
- Electronic Warfare Systems
- 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
- Operational Logistics, Joint
- Software Engineering
- Special Operations and Irregular Warfare
- Systems Analysis

**Graduate School of Business and Public Policy**
- Acquisition and Contract Management
- Contract Management
- Executive Management
- Executive Master of Business Administration
- Financial Management
- Information Systems Management
- Defense Business Management
- Defense Systems Analysis
- Defense Systems Management, International
- Material Logistics Support
- Manpower Systems Analysis
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Transportation Management

**Graduate School of Engineering and Applied Sciences**
- Applied Mathematics
- Combat Systems Science and Technology
- Electronic Systems Engineering
- Meteorology
- Meteorology and Oceanography
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors–Mechanical/Electrical Engineering
- Space Systems Engineering
- Space Systems Operations
- Systems Engineering
- Systems Engineering Management
- Undersea Warfare
- Underwater Acoustic Systems

**School of International Graduate Studies**
- Civil–Military Relations
- Combating Terrorism: Policy, Strategy
- Defense Decision Making and Planning
- Homeland Security and Defense
- Security Studies
- Stabilization and Reconstruction
- National Security and Intelligence:
  - Middle East, South Asia, Sub-Saharan Africa
  - Far East, Southeast Asia, Pacific
  - Europe and Eurasia
  - Western Hemisphere

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government, and foreign military officers and government civilians. The resident degree/sub-specialty student population for March 2012 is shown in Figure 1 on the following page.
**INTRODUCTION**

![Pie chart showing the distribution of DoD civilian, Army, Air Force, Marine Corps, Navy, and Other categories.]

*Army Reserve, Army Reserve National Guard, Coast Guard, National Oceanographic and Aeronautics Administration

Figure 1: Resident Degrees/Subspecialty Student Population for March 2012 (1,564 total)

**Academic Degrees**
Curricula meet defense requirements within the traditional degree framework. All curricula lead to a master’s; additional study may yield an engineer’s or doctoral degree. Below is a listing of the degrees offered at NPS:

**Master of Arts**
- Security Studies

**Master of Business Administration**

**Master of Science**
- Applied Mathematics
- Applied Physics
- Applied Science
- Astronautical Engineering
- Combat Systems Technology
- Computer Science
- Computing Technology
- Contract Management
- Cost Estimation and Analysis
- Defense Analysis
- Electrical Engineering
- Electronic Warfare Systems Engineering
- Engineering Acoustics
- Engineering Science
- Engineering Systems
- Human Systems Integration
- Information Operations
- Information Systems and Operations
- Information Technology Management
- Information Warfare Systems Engineering
- Management
- Mechanical Engineering
- Meteorology
- Meteorology and Physical Oceanography
- Modeling, Virtual Environments, and Simulation
- Operations Research
- Physical Oceanography
- Physics
- Product Development
- Program Management
- Remote-Sensing Intelligence
- Software Engineering
- Space Systems Operations
- Systems Analysis
- Systems Engineering
- Systems Engineering Analysis
- Systems Engineering Management
- Systems Technology

**Engineer**
- Astronautical Engineer
- Electrical Engineer
- Mechanical Engineer

**Doctor of Philosophy**
- Applied Mathematics
- Applied Physics
- Astronautical Engineering
- Computer Science
- Electrical Engineering
- Engineering Acoustics
- Information Sciences
- Mechanical Engineering
- Meteorology
- Modeling, Virtual Environments, and Simulation
- Operations Research
- Physical Oceanography
- Physics
- Security Studies
- Software Engineering
In March 2012, 165 degrees were conferred. Figure 2 indicates distribution by type, Figure 3 by degree area.

* Advanced degrees: applied physics (1), physics (1), software engineering (2)
** Other master’s degrees: applied math (1), defense analysis (10), electronic warfare systems engineering (1), physical oceanography (1), software engineering (1), space systems operations (1), engineering acoustics (2), information systems and operations (2), program management (2), systems engineering management (2)
INTRODUCTION

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 firsthand 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
# Table of Contents

## Master of Business Administration

An Administrative Workload and Cost Analysis for the Defense Security Cooperation Agency’s Foreign Military Sales .......................................................... 1
Analysis of Recruiter Refresher Training for the U.S. Navy .......................................................... 1
The Impact of the Medicare-Eligible Retiree Healthcare Fund on Navy Military Treatment Facilities’ Demand-to-Capacity Solution .......................................................... 2
Analysis of the Sustainment Organization and Process for the Marine Corps’ RQ-11B Raven Small, Unmanned Aircraft System (SUAS) .................................................................................. 2
USMC Aviation Maintenance and Repair Cost for the H-1 Upgrade .................................................. 3

## Master of Science

### Applied Mathematics
Computing the Algebraic Immunity of Boolean Functions on the SRC-6 Reconfigurable Computer .................. 7

### Computer Science
Cross-platform Mobile Application Development: A Pattern-Based Approach ............................................. 9
Utilizing Android and the Cloud Computing Environment to Increase Situational Awareness for a Mobile Distributed Response .......................................................... 9
Multiagent Task Negotiation Among UAVs to Defend Against Swarm Attacks ........................................... 10
Methods for Trustworthy Design of On-Chip Bus Interconnect for General-Purpose Processors .................. 10
The Unexplored Impact of IPv6 on Intrusion Detection Systems ....................................................................... 11
Open-Source Data-Collection Techniques for Weapons-Transfer Information .............................................. 11
Migrating Department of Defense Web-Service-Based Applications to Mobile Computing Platforms .......... 12
Data Transformation in a Three-Dimensional Integrated-Circuit Implementation ........................................... 12
Verification and Validation of the Malicious Activity Simulation Tool (MAST) for Network-Administrator Training and Evaluation .................................................................................. 13
Support for the Least-Privilege Separation Kernel ....................................................................................... 13
Design Proposal for a Highly Robust Peripheral Input Device Switch for a Multi-Level Secure System .......... 14
Mobile Phones Coupled with Remote Sensors for Surveillance ....................................................................... 14

### Defense Analysis
Out of the Blue: The NATO SOF Air Wing ................................................................................................. 15

### Electrical Engineering
Identification and Classification of Orthogonal, Frequency-Division, Multiple-Access (OFDMA) Signals Used in Next-Generation Wireless Systems .............................................................. 17
Emulation of Wind Power with a DC Machine to Provide Input Torque to a Doubly-Fed Induction Machine ................................................................................................................................. 17
Computing the Algebraic Immunity of Boolean Functions on the SRC-6 Reconfigurable Computer ............ 18
Wireless-Sensor Node Data Gathering and Location Mapping ........................................................................ 18

### Electronic Warfare Systems Engineering
High-Power, Quantum-Cascade Laser for Terahertz Imaging ....................................................................... 21

### Engineering Acoustics
Experimental Tracking of Aerial Targets Using the Microflown Sensor .................................................... 23

### Information Systems and Operations
How Virtual Technology Can Impact Total Ownership Costs on a USN Vessel .......................................... 25
TABLE OF CONTENTS

Effective Integration Through the Use of Social Influence Tactics: What the Military Can
Learn from Racial Integration of Baseball in Ending “Don’t Ask Don’t Tell”..................................................25

Information Technology Management
Hastily Formed Networks (HFNS) as an Enabler for the Emergency-Response Community...............................27
Information and Communications Technology Assessment Teams as a First Responder for
Humanitarian Assistance/Disaster Relief ...........................................................................................................27
Right Technology, Right Now: An Evaluation Methodology for Rapidly Deployable Information and
Communications Technologies in Humanitarian Assistance/Disaster Relief....................................................28
Virtual Desktop Infrastructures (VDIS) Supporting Agile Seabasing: A Study on Improving Embarkable
Integration Onboard Amphibious Flagships .......................................................................................................29
Bandwidth Management in Resource Constrained Networks ...........................................................................29

Management
The Effect of Advanced Education on the Retention and the Promotion of Surface-Warfare Officers
in the U.S. Navy .................................................................................................................................................31
The Effects of Combat Exposure on the Military Divorce Rate ........................................................................31
Development of a Markov Model for Forecasting Continuation Rates for Enlisted Prior Service and
Non-prior Service Personnel in the Selective Marine Corps Reserve (SMCR) ..................................................32
An Analysis of Personal and Professional Development in the United States Navy ........................................32
An Analysis of the Manpower Impact of Unmanned Aerial Vehicles on a Subsurface Platform ......................33
A Cost-Benefit Analysis of Fire Scout Vertical Takeoff and Landing Tactical, Unmanned, Aerial
Vehicle (VTUAV) Operator Alternatives .........................................................................................................33
United States Marine Corps Reserve First-Term Attrition Characteristics .....................................................34
Forecasting the Marine Corps’ Enlisted Classification Plan: Assessment of an Alternative Model ...............35
Estimating the ROI of Recruitment Marketing and Advertising Expenditure for the Australian
Defense Force ....................................................................................................................................................35
Analysis of Recruiter Refresher Training for the U.S. Navy ............................................................................36
Study of Personnel Attrition and Revocation Within U.S. Marine Corps Air-Traffic-Control Specialties ....36
An Examination of Individual Performance Using Markov Models in the Hellenic Navy’s
Officer-Performance Evaluation System .........................................................................................................37
Application of a Uniform-Price, Quality-Adjusted Discount Auction for Assigning Surface
Warfare Officer Retention Bonuses ................................................................................................................37
An Analysis of Sailors’ Academic Success in the Navy College Program Distance Learning
Partnership (NCPDLP) Schools .......................................................................................................................38
Retention of U.S. Navy Surface Warfare Officers Before and After the Global War on Terrorism ................38
Qualitative Analysis of Navy-Funded Graduate Education in Meeting HR Subspecialty
Billet Knowledge Requirements .........................................................................................................................39
Manpower Issues Involving Visit, Board, Search, and Seizure (VBSS) ............................................................39
Navy Nurse Corps Promotion During War: The Deployment Effect ................................................................40
Optimal Career Progression of Ground Combat Arms Officers in the Marine Reserve .................................40
Evaluating the Effectiveness of Navy Medical Corps Accession Programs ......................................................41

Mechanical Engineering
Synthesis and Characterization of Aluminum-Carbon Nanotube Composite Powders by
Cryogenic Milling ..................................................................................................................................................43
Adaptive Speed Controller for the Seafox Autonomous Surface Vessel ..........................................................43
Coordination and Control for Multi-Quadrotor UAV Missions ......................................................................44
Diffusion Couple Alloying of Refractory Metals in Austenitic and Ferritic/Martensitic Steels ......................44
Development and Analysis of a Bidirectional Tidal Turbine ............................................................................45
Fabrication and Optimization of Carbon Nanomaterial-Based Lithium-Ion Battery Anodes ............................45
Effects of Carbon Nanomaterial Reinforcement on Composite Joints Under Cyclic and Impact Loading ....46
## TABLE OF CONTENTS

Autonomous Underwater Vehicle Planning for Information Exploitation.......................................................... 46
Evaluation of Friction-Stir Processing of HY-80 Steel Under Wet and Dry Conditions ........................................ 47

**Meteorology**
The Potential Observation Network Design with Mesoscale Ensemble Sensitivities in Complex Terrain .... 49
Large-Scale Circulation Variability and Impact on North Indian Ocean Tropical Cyclones .............................. 49
A Mesoscale Model Analysis of Sea-Fog Formation and Dissipation Near Kunsan Air Base ............................. 50
A Statistical Multimodel Ensemble Approach to Improving Long-Range Forecasting in Pakistan ................ 50
Nowcasting Hail Size for Non-Supercell Thunderstorms in the Northeastern U. S. ........................................ 51
Potential Vorticity Streamers as Precursors to Tropical Cyclone Genesis in the Western Pacific....................... 51
Cloud Climatologies for Rocket-Triggered Lightning from Launches at Cape Canaveral Air Force Station and Kennedy Space Center ........................................................................................................ 52
Analysis of SFMR-Derived and Satellite-Based Rain Rates Over the Tropical Western North Pacific .......... 52
Evaluation of Non-Convective Wind Forecasting Methods in the 15th Operational Weather Squadron Area of Responsibility ..................................................................................................................... 53

**Meteorology and Physical Oceanography**
Verification of Cloud Analyses Used to Support Overhead Imagery Collection .................................................. 55
A Climatological Study of Hurricane Force, Extratropical Cyclones ................................................................. 55
Evaluation of Sea-Ice Kinematics and their Impact on Ice-Thickness Distribution in the Arctic ...................... 56
Climatological Factors Affecting Electromagnetic Surface Ducting in the Aegean Sea Region ....................... 56
High-Impact Weather Associated with a Predecessor Rain Event Over Misawa Air Base ............................... 57
Entrainment Zone Characteristics and Entrainment Rates in Cloud-Topped Boundary Layers from DYCOMS-II ........................................... 58
Upper-Ocean Characteristics in the Tropical Indian Ocean from AXBT and AXCTD Measurements ............. 58
Wave Reflection on a Two-Slope Steep Beach ..................................................................................................... 59

**Modeling, Virtual Environments, and Simulation**
A Naval Marksmanship Training Transfer Study: The Use of Indoor Simulated Marksmanship Trainers to Train for Live Fire ................................................................................................................ 61
Expertise on Cognitive Workloads and Performance During Navigation and Target Detection .................. 61
The Sea of Simulation: Improving Naval-Shiphandling Training and Readiness Through Game-based Learning ........................................................................................................................................ 62
Modeling of Helicopter Pilot Misperception During Overland Navigation .................................................... 63

**Operations Research**
Determining Optimal Evacuation Decision Policies for Disasters .................................................................... 65
Analysis of Self-Propelled Semi-Submersible Routes in the Eastern Pacific Ocean (U) ................................. 65
Optimizing Marine Corps Maintenance Personnel Conversion to the Joint-Strike Fighter .......................... 66
Measuring Combat Logistics Force (CLF) Adequacy in Supporting Naval Operations ............................. 66
Improving the Goodness-of-Fits Associated with the Current and Proposed Combat Active Replacement Factors (CARF) Methodology ...................................................................................... 67

**Physical Oceanography**
Observations of Hydraulic Roughness and Form Drag in the Wake of a Deep Ice Keel in the Arctic Ocean .................................................................................................................................................. 69

**Program Management**
Analyzing the Relative Cost, Effectiveness, and Suitability of Synchronous Training Versus Traditional On-Site Training Approaches ............................................................................................................ 71
# TABLE OF CONTENTS

**Space Systems Operations**  
Automating Nearshore Bathymetry Extraction from Wave Motion in Satellite Optical Imagery.............. 73

**Systems Engineering**  
Link Performance Analysis of a Ship-to-Ship Laser Communication System ................................................................. 75  
Developing Evaluation Measures for the Second Stage Next Generation Engine on Evolved Expendable Launch Vehicles .................................................................................................................. 75  
Embarkables Root Cause for Navy Networks .......................................................................................................................... 76  
Application of an Entropic Approach to Assessing Systems Integration......................................................................................... 76

**Systems Engineering Management**  
A System-Engineering Analysis of Squadron Officer College ................................................................................................. 77  
Three Approaches to Space-Systems Acquisition and their Application to the Defense Department’s Weather-Satellite Program ......................................................................................................................... 77

**MASTER OF ARTS**

**Security Studies**  
The Strategic Alternatives of the Gulf Cooperation Council (GCC): Disruption of Maritime Traffic in the Arabian Gulf as a Result of Iranian Threats to Close the Strait of Hormuz ............. 81  
Force Protection for Firefighters: Warm Zone Operations at Paramilitary-Style, Active-Shooter Incidents in a Multi-Hazard Environment as a Fire-Service Core Competency .................................................................................................................. 81  
Creation of a Homeland Security Jail Information Model ......................................................................................................... 82  
Stone Soup: A Recipe for Building Resiliency Among Children .................................................................................................. 82  
Risk-Based Aviation Security: Diffusion and Acceptance ......................................................................................................................... 83  
Whistleblowing in a Wikileaks World: A Model for Responsible Disclosure in Homeland Security .................................................. 83  
Beyond the Washington Consensus: Promoting Economic Growth and Minimizing the Threat of Violence in Latin America Through Social Development ......................................................................................... 84  
Pakistan's First Military Coup: Why Did the First Pakistani Coup Occur and Why Does It Matter? .................. 84  
The Impacts of Social Media on Citizen Security Behavior in Mexico ................................................................................................. 85  
Identity-Verification Systems as a Critical Infrastructure ............................................................................................................. 85  
Civilian Protection in the Eastern Democratic Republic of the Congo: Evaluation of the Monusco Peacekeeping Operation ........................................................................................................................................... 86  
The Significance of Fire-Service Culture as an Impediment to Effective Leadership in the Homeland-Security Environment ................................................................................................................................. 86  
What’s My Lane? Identifying the State Government Role in Critical-Infrastructure Protection ........................................................................ 87  
History as the Architect of the Present: What Made Kashmir the Nucleus of South Asia Terrorism? ....... 87  
India–Pakistan Conflict and Its Impact on U.S. Homeland Security ................................................................................................. 88  
The Nation That Cried Lone Wolf: A Data-Driven Analysis of Individual Terrorists in the United States Since 9/11 ........................................................................................................................................ 88  
The Veil of Kevlar: An Analysis of Female Engagement Teams in Afghanistan .................................................................................. 89  
More Airfields Equals More Opportunities .................................................................................................................................... 90  
The Challenge of Small-Satellite Systems to the Space-Security Environment ................................................................................ 90  
Lessons from the Past: Vital Factors Influencing Military Advisors in Korea, Vietnam, and Afghanistan ........................................... 91  
Assessing the Impact of Social Media on the 25 January 2011 Egyptian Revolution ............................................................................. 91  
Getting Serious About Games—Using Video-Game-Based Learning to Enhance Nuclear-Terrorism Preparedness ........................................................................................................................................... 92  
Japan's Self-Defense Forces After the Great East Japan Earthquake: Toward a New Status Quo ................................................................................................................................. 92  
The Role of Military in Post-Conflict Sri Lanka .................................................................................................................................... 93  
Improved Web 2.0 Strategy for FEMA to Enable Collaboration and a Shared Situational Awareness Across the Whole of Community ................................................................................................................. 93
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossing the River: A Conceptual Framework for Response to Chaos</td>
<td>94</td>
</tr>
<tr>
<td>How Should Public Administration Education Curriculum Within Indiana</td>
<td>94</td>
</tr>
<tr>
<td>Higher Education Institutions Evolve to Reflect the Complex Homeland</td>
<td>94</td>
</tr>
<tr>
<td>Security Issues Faced by Future Public Sector Employees?</td>
<td></td>
</tr>
<tr>
<td>Re-integration of Former Liberation Tigers of Tamil EELAM Combatants</td>
<td>95</td>
</tr>
<tr>
<td>into Civilian Society in Post-War Sri Lanka</td>
<td></td>
</tr>
<tr>
<td>Counterinsurgency Principles for Contemporary Internal Conflict</td>
<td>96</td>
</tr>
<tr>
<td>Creation of a United States Emergency Medical Services Administration</td>
<td>96</td>
</tr>
<tr>
<td>Within the Department of Homeland Security</td>
<td></td>
</tr>
<tr>
<td>Health Security Intelligence: Assessing the Nascent Public-Health</td>
<td>97</td>
</tr>
<tr>
<td>Capability</td>
<td></td>
</tr>
<tr>
<td>Smallpox as a BioWeapon: Should We Be Concerned?</td>
<td>97</td>
</tr>
<tr>
<td>Your Faith, My Fear: Countering Consent to Cosmic Positioning</td>
<td>98</td>
</tr>
<tr>
<td>Concept of Operations for CBRN Wireless-sensor Networks</td>
<td>98</td>
</tr>
<tr>
<td>Iranian Sanctions: An Actor-Centric Analysis</td>
<td>99</td>
</tr>
<tr>
<td>The Use of an Enhanced Polygraph Scoring Technique in Homeland</td>
<td>99</td>
</tr>
<tr>
<td>Security: The Empirical Scoring System—Making a Difference</td>
<td></td>
</tr>
<tr>
<td>Korea’s Post-Conflict Peace Operations:</td>
<td>100</td>
</tr>
<tr>
<td>A Comparative Assessment of Korean Combat Battalions in East Timor</td>
<td>100</td>
</tr>
<tr>
<td>and Lebanon</td>
<td></td>
</tr>
<tr>
<td>Bridging the Gulf: A New Paradigm for Emergency Management on America’s</td>
<td>100</td>
</tr>
<tr>
<td>Third Border</td>
<td></td>
</tr>
<tr>
<td>Resilient Communication: A New Crisis Communication Strategy for</td>
<td>101</td>
</tr>
<tr>
<td>Homeland Security</td>
<td></td>
</tr>
<tr>
<td>Success and Failure in Doctrinal Innovation: A Comparison of the U.S.</td>
<td>102</td>
</tr>
<tr>
<td>Army Medical Department and Logistics Branch, 1990–2010</td>
<td></td>
</tr>
</tbody>
</table>
This research addresses a request by the Defense Security Cooperation Agency (DSCA) to identify and model workload measures associated with foreign military sales (FMS) that can be used to predict increases or decreases in future resource requirements.

The DSCA requested that this study use workload and budget data for FY2007 through FY2011, due to a different surcharge rate as well as budget restrictions in the prior years. This research focused on the three military Services—the Army, Air Force, and Navy, which account for 80% of all FMS cases. Although all services are required to follow the Department of Defense acquisition model, each service uses unique methods to acquire equipment and services.

Using trend analysis and parametric cost-estimating techniques, a workload model was created for each service using multiple cost drivers. On average, the models explain 88% of the variation in the allocated budgets from FY2007 to FY2011 for all Services, with a standard error equal to approximately 7% of the FY2011 budget. If DSCA were to choose one model, line count is recommended. However, in order to reduce standard error, an average of all statistically significant cost drivers is the best fit model.

**KEYWORDS:** Lossless Data Compression, Discrete Mathematics, Analysis of Algorithms, Huffman coding, Rotational Tree, Index Tree

This thesis analyzes the training continuum for Navy recruiters coming from the fleet. Specifically, the study examines the current training pipeline and the theories of how people learn, why they learn, and how they retain information. The study focuses on the uniqueness of recruiting assignments, recruiter training requirements, the 2011 recruiting environment, the Navy Recruiting Command organization, and the influence of incentives on recruiting performance.

The training cycle for the main selling tool, Professional Selling Skills, is analyzed based on elements of learning, forgetting, and motivation. The purpose is to strengthen the training continuum and help mitigate potential recruiting difficulties in the years ahead. The primary sources of information are Navy Recruiting Command instructions and basic learning and motivational theories.
This study suggests ways to support the training continuum by ensuring that recruiters are provided with standardized and comprehensive training throughout their recruiting tour. Periodic refresher training would ultimately boost individual recruiter productivity as well as strengthen on-the-job training. In addition to reinforced training, new motivational factors and incentives can augment the training continuum. Recommendations are provided to improve the current training continuum with recruiting simulators and enhanced incentives.

**KEYWORDS:** Navy Recruiting, Training, Incentives, Recruiter Incentive, Freeman Plan, Bloom's taxonomy, Skill Decay, Professional Selling Skills (PSS), Motivation

THE IMPACT OF THE MEDICARE-ELIGIBLE RETIREE HEALTHCARE FUND ON NAVY MILITARY TREATMENT FACILITIES’ DEMAND-TO-CAPACITY SOLUTION

Amy Nodine B. Sulog—Lieutenant Commander, United States Navy

Master of Business Administration—March 2012

Lead Advisor: Richard Doyle, Graduate School of Business and Public Policy
Support Advisor: Chong Wang, Graduate School of Business and Public Policy

The Medicare-Eligible Retiree Healthcare Fund (MERHCF) covers the medical benefits provided to Medicare-eligible retirees and dependents of the uniformed services. A comparative analysis of two Navy military treatment facilities identified the impacts of MERHCF on their respective demand-to-capacity solutions. The common elements of a Health Care Requirement Analysis (HCRA) and best business practices were used to show the challenges of MTFs in providing medical care to an increasing population and health care of Medicare-eligible military retirees and their families. The analysis showed that MERHCF provides an opportunity for Navy MTFs to maximize the reimbursement and recapture outsourced patrons by optimizing the effectiveness and cost efficiency of staffing and resources to deliver healthcare for the maximum number of beneficiaries.

**KEYWORDS:** Medicare-Eligible Health Care Fund, MERHCF, Military Treatment Facility, Demand-to-Capacity Solutions, Health Care Requirements Analysis

ANALYSIS OF THE SUSTAINMENT ORGANIZATION AND PROCESS FOR THE MARINE CORPS’ RQ-11B RAVEN SMALL, UNMANNED AIRCRAFT SYSTEM (SUAS)

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B.A., University of Pennsylvania, May 2001

Master of Business Administration—March 2012

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

The purpose of this study is to outline and analyze the acquisition and sustainment process for the current U.S. Marine Corps’ RQ-11B Raven Digital Data Link small unmanned aerial system program. The current sustainment of the Marine Corps’ Raven evolved from the support employed for its predecessor analog variant in 2008, which was originally supported by Marine organic assets below depot-level maintenance requirements. The Raven’s manufacturer, AeroVironment Inc., now stations a field service representative in theater and has been since around June 2011 under a contractor logistics support contract after the Marine Corps struggled to implement organic support and sustain its Ravens at the organizational and intermediate levels.

This report serves as a case study for insights into the acquisition strategies for future unmanned systems. I explore the advantages and limitations of organic versus contractor support options in the form of monetary, organizational, and logistical resource allocation by analyzing the spectrum of solutions throughout the supply and maintenance constructs. The analysis covers both operational and sustainment perspectives through the
lens of doctrine, organization, training, material, leadership and education, personnel, and facilities implications.

**KEYWORDS:** Marine Corps, USMC, SUAS, RQ-11B Raven, Sustainment, Supply, Maintenance, Contractor Logistics Support, CLS, UAS, Unmanned Aerial System, DOTMLPF, Acquisitions

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**USMC AVIATION MAINTENANCE AND REPAIR COST FOR THE H-1 UPGRADE**

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Master of Business Administration—March 2012

Lead Advisor: Lawrence R. Jones, Graduate School of Business and Public Policy

Support Advisor: Donald Summers, Graduate School of Business and Public Policy

This research focuses on the Marine Corps Aviation Maintenance and Repair Cost for the H-1 Upgrade platform. Onsite visits with the Program Manager Air 276 (PMA-276), the Naval Supply Weapons Systems Support (NAVSUP WSS), the Defense Logistics Agency (DLA), and Marine Aviation Logistics Squadron 39 (MALS-39) are conducted to obtain information regarding readiness costs and efficiencies that have impacted the total cost for a transitioning aircraft in Marine aviation. PMA-276, NAVSUP WSS, DLA, and MALS-39 make up the H-1 Cross-Functional Team (CFT). The H-1 CFT provides actionable metrics and best practices that focus on cost concerns (programmatic, material, management, and execution) from all levels of aviation logistics and planning. Key areas of improvement or replication are identified through metric-based solutions that affect cost reductions throughout the AH-1Z and UH-1Y integration.

**KEYWORDS:** Aviation Maintenance, Repair Cost, Cross-Functional Team
MASTER OF SCIENCE

Applied Mathematics
Computer Science
Defense Analysis
Electrical Engineering
Electronic Warfare Systems Engineering
Engineering Acoustics
Information Systems and Operations
Information Technology Management
Management
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Program Management
Space Systems Operations
Systems Engineering
Systems Engineering Management
Boolean functions with high algebraic immunity (AI) are vital in reducing the possibility of utilizing algebraic attacks to break an encryption system. Simple algorithms exist to compute the AI of a given $n$-variable Boolean function, but the time required to test a large number of functions is much greater on conventional computing systems. AI was computed for all functions through $n = 5$ using the SRC-6. AI was also computed for $n = 5$ using a C algorithm. The SRC-6 performed 4.86 times faster than a conventional processor for this computation. It is believed that this is the first enumeration of all 5-variable functions with respect to AI.

Monte Carlo trials were performed for $n = 6$, both on the SRC-6 and utilizing a C algorithm on a conventional processor. These trials provided the first known distribution of AI for 6-variable functions.

Some algorithms for computing AI require a conversion between the truth table form of the function and its algebraic normal form. The first known Verilog implementation of a reduced transeunt triangle was developed for this conversion. This reduced form requires many fewer gates and has $O(n)$ delay versus $O(2^n)$ delay for a full transeunt triangle.

**KEYWORDS:** Algebraic Immunity, Cryptography, Boolean Functions, Transeunt Triangle, Reconfigurable Computing, SRC-6, FPGA, Verilog, Algebraic Attack
Mobile devices are fast becoming ubiquitous in today’s society. New devices are constantly being released with unique combinations of hardware and software, or platforms. In order to support the ever-increasing number of platforms, developers must embrace some method of cross-platform development in which the design and implementation of applications for different platforms may be streamlined.

This thesis compares and contrasts two platforms, iOS and Android smartphones, and discusses how one might apply the Model, View, Controller pattern in order to minimize the inherent differences between the platforms. Furthermore, this thesis describes the Unified Design Process that can be used to implement native iOS and Android applications from a single design process. This design process reduces the amount of time required for the development of applications and maintains platform specific UI styles for the different platforms.

The authors used this process to design and build a functional prototype of the NPS Muster application on both platforms. This application is capable of displaying announcements and allowing NPS students to conduct daily musters.

**KEYWORDS:** Mobile Programming, Android, iOS, Unified Design Process

Maintaining an accurate Common Operational Picture (COP) is a strategic requirement for efficient and successful missions in both disaster response and battlefield scenarios. Past practices include utilizing cellular, radio, and computer based communication methods and updating individual maps accordingly. A drawback of these practices has been interoperability of these devices as well as accurate reporting and documentation among different entities of the effort.

Recent advances in technology have led to the utilization of collaborative maps for maintaining a COP.
amongst command centers. Despite the advantages this technique offers, it does not address the difficulties surrounding receiving reports from field entities as well as ensuring these entities also have good situational awareness. The goal of this research is to explore smartphone capabilities in conjunction with cloud computing to determine how they can extend the benefits of collaborative maps to mobile users while simultaneously ensuring command centers are receiving accurate, up-to-date reports from the field.

**KEYWORDS:** Android Programming, Cloud Computing, Common Operating Picture, Web Programming

### MULTI-AGENT TASK NEGOTIATION AMONG UAVS TO DEFEND AGAINST SWARM ATTACKS

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Master of Science in Computer Science—March 2012  
Co-Advisor: Timothy H. Chung, Department of Systems Engineering  
Co-Advisor: Chris Darken, Department of Computer Science

This research involves a multi-agent based simulation modeling a large swarm of adversarial UAVs attacking a surface target and groups of friendly UAVs responding to thwart the attack. Defense systems need to cooperatively negotiate which enemy systems to engage to maximize the number of aggressor systems destroyed. Using optimal centralized task assignment methods as a baseline, various distributed methods are examined for efficiency and effectiveness. Our findings indicate that the optimality of distributed methods does approach that of centralized methods, though further study is warranted in future simulations with additional constraints, and in field experimentation with physical UAVs. We further find that the number of defender agents, the effectiveness of their weapon systems, and their speeds contribute significantly to the defender swarm’s effectiveness.

**KEYWORDS:** Agent-Based Systems, Autonomous Agents, Modeling and Simulation, Unmanned Systems

### METHODS FOR TRUSTWORTHY DESIGN OF ON-CHIP BUS INTERCONNECT FOR GENERAL-PURPOSE PROCESSORS

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Master of Science in Computer Science—March 2012  
Advisor: Theodore D. Huffmire, Department of Computer Science  
Second Reader: J.D. Fulp, Department of Computer Science

Military electronics rely on commodity processors, many of which are manufactured overseas where the trustworthiness of the foundries is uncertain. This thesis attempts to answer the question of whether common bus protocols in use today differ significantly with respect to security, by conducting an analysis of common integrated circuit bus protocols (Inter-Integrated Circuit [I2C], Advanced Microcontroller Bus Architecture [AMBA], HyperTransport, Wishbone, and CoreConnect) based on the Flaw Hypothesis Methodology (FHM). This thesis follows the four stages of FHM. The first stage is Flaw Generation, which involves creating hypothetical attack scenarios. The next is Flaw Confirmation, which involves confirming the flaws generated in the first stage through analysis of the specifications of the bus architectures as well as testing and research in the literature. The third stage is Flaw Generalization, which evaluates the impact of each flaw to determine whether it suggests that a more serious flaw exists in that bus architecture. The final stage is Flaw Elimination, which identifies strategies (and their costs) for mitigating the vulnerabilities based on techniques in the hardware security literature. We conclude that the bus architectures we analyzed differ significantly with respect to security.
**THE UNEXPLORED IMPACT OF IPV6 ON INTRUSION DETECTION SYSTEMS**

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Master of Science in Computer Science–March 2012  
Advisor: Robert Beverly, Department of Computer Science  
Second Reader: J.D. Fulp, Department of Computer Science

With DoD networks steadily adopting and transitioning to the next generation Internet Protocol, IPv6, careful consideration must be given to IPv6-specific implications on network protection. While Network Intrusion Detection Systems (NIDS) assist in protecting current IPv4 DoD networks, NIDS performance in operational DoD IPv6 environments is largely unknown. As a step toward more rigorous NIDS evaluation, we investigate the extent to which known IPv4 attacks are able to evade detection when converted to equivalent IPv6 attacks. Utilizing 13 general attack classes, we test the IPv6 readiness of two popular open source NIDSs: SNORT and BRO. Attacks in each class are evaluated in a virtual test bed that models both “native” and “transitional” networks. In the native IPv6 environment, we achieve a 95% detection rate for SNORT as compared to 8% with BRO. In addition, we discover a bug in SNORT where a carefully crafted IPv6 packet causes the NIDS to fail open, allowing full circumvention. Our findings suggest that, with respect to IPv6, both NIDS signatures and NIDS software require additional testing and evaluation to be operationally ready.

**KEYWORDS:** Network Intrusion Detection Systems, Snort, Bro, IPv6, Detection, Fuzz Testing

**OPEN-SOURCE DATA-COLLECTION TECHNIQUES FOR WEAPONS-TRANSFER INFORMATION**

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B.S., Clemson University, May 2007  
Master of Science in Computer Science–March 2012  
Advisor: Neil C. Rowe, Department of Computer Science  
Second Reader: Joel D. Young, Department of Computer Science

Monitoring weapons proliferation requires detecting and tracking weapons transfers. Many public sources of weapons-transfer data come from incomplete and manually collected and maintained government and commercial records. We propose a technique to gather weapons-transfer information by mining publicly available Web pages for features, which we categorize as arms, actions, actors, or money. We design a retrieval system and parser, and develop techniques for extracting currency values from text, measuring precision without available training data, and measuring recall with a parallel but different corpus. Results show that, of the sentences matching four feature categories, 70% of relevant features were found, and sentences that only matched three categories introduced more false positives. We conclude that such a technique can improve the speed at which transfer information is compiled.

**KEYWORDS:** Data mining, crawler, natural language processing, weapon
This thesis explores techniques for extending Department of Defense (DoD) information technology (IT) capability from web-based desktop clients to mobile platforms. Specifically, we examine how existing data services can be consumed by native and web-based mobile clients without modification to the services. We consider the data access layer, the User Interface (UI) design, and the Total Cost of Ownership (TCO) as areas to compare and contrast each implementation. We develop a web-based application and implement comparable capability on native and web-based mobile clients. We determined that native applications and mobile aware web applications are capable of consuming an existing web service without modifying the service. In general, we find no clear advantage between our mobile implementations when consuming existing web services and maintaining a consistent UI. We found that, while developing a data access module, it is difficult to share code between an existing web application and a native mobile application. We find that where appropriate, a mobile aware web application excels because it maintains a single code baseline.

**KEYWORDS:** Web Service, Mobile Computing

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Three-dimensional integration is an emerging chip-fabrication technique in which multiple integrated-circuit dies are joined using conductive posts. 3D integration offers several performance and security advantages, including extremely high bandwidth between the two dies and the ability to augment a processor with a separate die housing custom security features. This thesis performs a feasibility and requirements analysis of a data-transformation coprocessor in a three-dimensional integrated circuit. We propose a novel coprocessor architecture in which one layer (the control layer) houses application-specific coprocessors for cryptography and compression, which provide acceleration for applications running on a general-purpose processor in another layer (the computational layer).

The main application supported from our proposed 3DIC is the one that performs real-time trace collection, compresses the trace, and optionally encrypts the compressed trace, which protects the data from interception during transmission to permanent off-chip storage for offline program analysis.

Although we are not building a hardware device for simulation we present the architecture for a 3D data transformation processor and a rationale for each of the key design decisions, including a compression study that determined the optimal compression algorithm for a specific set of traces.

**KEYWORDS:** Three Dimensional Integrated Circuit, Compression, Cryptography, Coprocessor, Data Transformation, Control Plane, Computational Plane
The DoD currently employs red teams to conduct network infiltration and security training for network administrators and operators. Red teams provide the most realistic and thorough training to defend against real-world threats and we are developing a system to mimic this highly trained adversary based on the proof of concept framework developed by CDR Will Taff and LCDR Paul Salevski.

This thesis is meant to perform a verification and validation analysis of the suitability of the MALWARE Mimic concept as a methodology for conducting network administrator network security training and awareness, alleviation of red team availability constraints, and network user security awareness training. We also develop a strategy by which the effectiveness of the MALWARE Mimic system for increasing such network security awareness and elevating the information assurance posture of distributed command networks can be measured.

**KEYWORDS:** Red Team, Malware, Network Administrator Training, Computer Network Defense

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**SUPPORT FOR THE LEAST-PRIVILEGE SEPARATION KERNEL**

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MTech, Institute of System Sciences, National University of Singapore, Singapore, 2004
Master of Science in Computer Science–March 2012
Advisor: Paul C. Clark, Department of Computer Science
Co-Advisor: Cynthia E. Irvine, Department of Computer Science

The objective of the Trusted Computing Exemplar (TCX) project is to construct a useful example of a high-assurance component as a reference model for building high-assurance systems. The targeted exemplar component is the least privilege separation kernel (LPSK). The LPSK currently exists in the form of a partially implemented prototype. With respect to support for external computer peripherals, the prototype LPSK currently supports visual display units (e.g., LCD monitors) for output and PS/2 keyboards for user inputs. The PS/2 interface is a technology that is fast disappearing from computer systems. To keep the support for external computer peripherals up to date, support for other interface standards such as USB is required. This work has identified and ported part of the USB implementation (i.e., USB bus driver, UHCI driver and hub driver) from an open-source BIOS called Sea BIOS to the LPSK. The problems encountered in the course of porting, together with their solutions, are presented to facilitate future work. Tests were conducted to ensure correct behavior of the ported code.

**KEYWORDS:** TCX project, LPSK, USB standards, HID class driver and PCI BUS
A number of commercial vendors have tried to develop peripheral input device switches to provide high robustness, but most fail to achieve the assurance level necessary for use in a multi-level secure system. This paper provides the groundwork for designing a highly robust peripheral input device switch for universal serial bus (USB) keyboards and mice by defining the requirements, the external and internal interfaces, the data flows, and the state diagrams of the switch. All of these are used to show that only a single computer connected to the switch is allowed to communicate with the attached keyboard and mouse at any given point in time, a “Flush” command must precede any connection between an attached computer and the keyboard and mouse, and no two CPPs are allowed to communicate with each other through the switch.

**KEYWORDS:** KVM Switch, USB KVM Switch, High Robustness, Multi-Level Secure, Secure Component Development, Information Assurance Design

Highly mobile maneuver units require the ability to rapidly provide perimeter defense for their assets. Remote sensors, combined with wireless networks and Smartphones, offer a means to reduce manpower impacts of perimeter surveillance. The unit can deploy sensors around their perimeter and/or key locations, and use the Smartphone to monitor them. These sensors can be used to detect personnel and vehicles depending upon the sensors’ capabilities.

To demonstrate this, a Smartphone running the Android 2.3 OS and various sensors manufactured by Phidgets, Inc., are used to develop a real-time surveillance system. The system capabilities include wireless transmission of data and detection of vibration, movement, infrared motion, and sound. The limitations of our study are that Phidgets sensors rely on external power, are not weather-resistant, and have to be plugged into a control board to operate. A fully functional system designed to support the needs of maneuver units in virtually any operating environment would enhance the unit’s capabilities and security.

**KEYWORDS:** Android, Sensors, Phidgets, Wi-Fi, Wireless, Surveillance
There is a critical shortfall in dedicated special operations aviation support for NATO's special operations forces. One way this shortfall can be addressed is through the procurement and sustainment of an organic NATO SOF Air Wing. In 2006, the North Atlantic Treaty Organization's (NATO) Heads of State and Governments endorsed the NATO Special Operations Forces Transformation Initiative, creating what would eventually become the NATO Special Operations Headquarters (NSHQ). NSHQ coordinates, trains, and employs NATO's special operations forces (SOF). These forces have proven invaluable in fighting asymmetric threats due to their light, lean, and agile construct, and their versatile projection of high-impact tactics, techniques, and procedures that create strategic effects.

The research in this study examines NSHQ's requirement for an organic Air Wing and proposes the optimal mix of aviation platforms to support NATO SOF. This optimal mix contains rotary-wing and fixed-wing aviation platforms, as well as intelligence, surveillance, targeting, and reconnaissance aircraft. This research also examines NSHQ's training and readiness organizational structure, and proposes changes based on the development of an organic Air Wing. Dedicated special operations aviation support to NATO special operations forces will greatly enhance the capabilities and mission success of NATO SOF in addressing emerging security challenges.

**KEYWORDS:** NATO SOF, NATO SOF Air Wing, AFSOTC, NSHQ, NSHQ Training and Readiness, NATO SOF Training and Education Program, ISTAR, Principal Tasks, NATO Special Operations Headquarters
This thesis explores the identification and classification of orthogonal, frequency-division, multiple-access-based signals and proposes a scheme to achieve this goal. Specifically, the cyclostationary pilot signature of an IEEE 802.16e standard compliant waveform is investigated. The proposed scheme performs waveform identification through a preamble cross-correlation technique. Classification is achieved through the use of a pilot cross-correlation technique in combination with an algorithm called the fast Fourier transform accumulation method that performs cyclostationary feature extraction in order to determine the cyclic prefix of the IEEE 802.16e waveform. Similar methods are then used for determining other OFDMA waveform parameters, such as the FFT size, Segment number and IDcell. The proposed scheme is implemented with MATLAB simulation code and the significant results of the simulation are presented and discussed. The MATLAB simulation validated the preamble cross-correlation process and the pilot cross-correlation technique in conjunction with the fast Fourier transform accumulation method as effective methods of signal identification and classification, respectively.

**KEYWORDS:** IEEE 802.16e, OFDMA, Cyclostationary Feature Extraction

The behavioral modeling of a separately excited, direct-current (DC) motor as a prime mover for a doubly-fed induction machine (DFIM) is studied in this thesis. The output torque of the DC motor is computed in the simulation under controlled parameters. The input to the DFIM, used as a doubly-fed induction generator (DFIG), is taken from the DC motor. In theory, the combination of the two machines can be used to emulate various wind patterns and their expected electrical returns for a given DFIM-based wind turbine.

A Simulink model was created to appropriately emulate the operation of the DC machine. That model was then incorporated into an existing model of a DFIM. The resulting simulations are compared to system operating data to determine if machine speed is being correctly modeled. The speeds determined by the simulator accurately track those that are gathered from lab data. Operating speeds of the system were mapped to historical wind speeds in a geographical area. Output power
of the DC motor for the different operating speeds was calculated and plotted. The data confirmed the theory of the proportionality of the rotational output power of a DC motor.

**KEYWORDS:** Direct Current (DC) Motor, Doubly-Fed Induction Generator (DFIG), Doubly-Fed Induction Machine (DFIM), Wind Power, Simulink Model

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**COMPUTING THE ALGEBRAIC IMMUNITY OF BOOLEAN FUNCTIONS ON THE SRC-6 RECONFIGURABLE COMPUTER**

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Master of Science in Electrical Engineering–March 2012

Master of Science in Applied Mathematics–March 2012

Advisor: Jon T. Butler, Department of Electrical and Computer Engineering

Co-Advisor: Pantelimon Stanica, Department of Applied Mathematics

Boolean functions with high algebraic immunity (AI) are vital in reducing the possibility of utilizing algebraic attacks to break an encryption system. Simple algorithms exist to compute the AI of a given $n$-variable Boolean function, but the time required to test a large number of functions is much greater on conventional computing systems. AI was computed for all functions through $n = 5$ using the SRC-6. AI was also computed for $n = 5$ using a C algorithm. The SRC-6 performed 4.86 times faster than a conventional processor for this computation. It is believed that this is the first enumeration of all 5-variable functions with respect to AI.

Monte Carlo trials were performed for $n = 6$, both on the SRC-6 and utilizing a C algorithm on a conventional processor. These trials provided the first known distribution of AI for 6-variable functions.

Some algorithms for computing AI require a conversion between the truth table form of the function and its algebraic normal form. The first known Verilog implementation of a reduced transeunt triangle was developed for this conversion. This reduced form requires many fewer gates and has $O(n)$ delay versus $O(2^n)$ delay for a full transeunt triangle.

**KEYWORDS:** Algebraic Immunity, Cryptography, Boolean Functions, Transeunt Triangle, Reconfigurable Computing, SRC-6, FPGA, Verilog, Algebraic Attack

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**WIRELESS-SENSOR NODE DATA GATHERING AND LOCATION MAPPING**

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Master of Sciences in Electrical Engineering–March 2012

Advisor: Weilian Su, Department of Electrical and Computer Engineering

Second Reader: Xiaoping Yun, Department of Electrical and Computer Engineering

With advances in wireless communications and miniaturization of mobile sensors, wireless-sensor nodes are increasingly being deployed in ad hoc fashions. Efficiently gathering data from the networks now becomes a larger problem. Collecting sensor data from a group of nodes deployed in an unknown arrangement in the shortest amount of time requires the collector to utilize a methodology that minimizes collection overlap. Inexpensive commercial off-the-shelf wireless routers and mobile platforms that can be utilized to fly over a field of wireless nodes and create a link connecting to and retrieving the maximum amount of data, are examined in this thesis. The problems are two-fold: first, the necessary task of locating the wireless devices in a given area, querying these devices to collect raw data for positioning, and second, the task of then creating a static map of derived locations.

In order to enumerate device locations, the relationship of signal strength measurements and round-trip signal times between wireless nodes and the wireless access router were investigated in this thesis. The results
of this research support the conclusion that an inexpensive collection system can be readily configured for the task of automated client surveying and distance approximation.

**KEYWORDS:** IEEE 802.11 Standards, Wireless sensor networks, Mobile ad hoc networks
Video rate or real-time imaging in the terahertz (THz) frequency range has become possible in the last few years with the advent of compact and high-power THz sources, such as quantum-cascade (QC) lasers, and the THz-sensitive, vanadium-oxide-based microbolometer focal plane arrays. A new, higher power QCL had been acquired and was characterized using FTIR spectroscopic techniques as part of this thesis. Spectral analysis revealed the center radiation frequency to be about 3.78 THz, which was close to the manufacturer’s specification. Relative power analysis showed significantly higher magnitude, of at least two orders, than the previous low-power QCL. Significant temperature build-up of the cryostat, where the laser was mounted, was noticed in terms of a temperature rise of about 16 Kelvins, but was not detrimental to laser performance. Active real-time THz imaging was conducted with the laser and a 160 x 120 element microbolometer focal plane array camera, FLIR A20M. The off-axis parabolic (OAP) reflective mirrors were re-configured for the imaging experiment to ensure sufficient THz energy would be focused onto the object. This optical setup could be easily re-configured for either transmission mode, as well as reflective mode imaging experiments. A synchronization circuitry was designed to synchronously modulate the QCL pulses with the focal plane array for differential imaging. This operation would eliminate unwanted signals from the infrared background, obviating the need for dedicated spectral filters that would have significantly attenuated the THz signal as well. Preliminary experiments showed better contrast in the acquired images. Post-processing algorithms such as addition of digital gain, enhanced edges, and integration of multiple images could potentially enhance the quality of the THz images, and extend the research towards reflective and stand-off THz imaging.

**KEYWORDS:** Terahertz, Real-Time Imaging, Quantum Cascade Lasers, Microbolometer, Focal Plane Arrays
Determining target bearing based on a passive acoustic signal typically relies on beamforming the signals from an array of sound-pressure sensors. A major drawback, however, is the proportional increase in array aperture when dealing with low frequencies, such as the lengthy towed arrays used for antisubmarine warfare. This thesis demonstrates the use of a single acoustic vector sensor (Microflown Ultimate Sound Probe [USP]) to derive the target bearing by processing both the pressure and particle velocity of an acoustic wave.

Field experiments were set up to track commercial aircraft during their final approach before landing. Despite healthy signal-to-noise (SNR) ratios, significant challenges were faced in accurate real-time tracking. Post-processing frequently achieved better results, but required the beamformer to process a broader range of frequencies (typically 300-1000 Hz), instead of focusing on narrowband energy peaks. This was attributed to the effects of noise and bottom reflections (mainly from the concrete ground), as implied by the distinct Lloyd's mirror patterns in the spectrograms. Notwithstanding, additional information such as target altitude and horizontal distance at the closest point of approach (CPA) could be determined from analyzing these patterns.

KEYWORDS: Acoustic Vector Sensor, Particle Velocity, Beamforming, Noise, Microflown, Real-time Tracking, Aircraft
This thesis investigates the development of virtual technology and how the Consolidated Afloat Network Enterprise Services (CANES) program can reduce total cost of ownership when a ship’s local-area networks are upgraded. With the recent development of cloud computing technologies, everyone from Fortune 500 companies to defense organizations believes that there are tangible benefits to moving operations to the cloud. This idea is particularly resonant with Naval Surface operations, consistent with the downsizing of personnel on surface ships, and with the Chief of Naval Operation’s vision for information systems to be agile, relevant, and cost effective. By building a scalable private cloud model that utilizes a centralized server for computer processing, thin client workstations were compared to current thick client architectures onboard surface vessels. With multicore server processors developed to handle several tasks simultaneously, the ability to consolidate and virtualize multiple servers and workstations aboard naval vessels is now possible from a blade server chassis. By consolidating the computer processing into a central location, total ship energy consumption could be reduced by 31 kilowatts during peak usage. The reduced shipboard energy consumption cut shore power costs by $3.75 per hour and reduced fuel consumption by 2,400 gallons each operating quarter for a ship using ships service gas turbine generators (SSGTG). Even with increased research and developments costs associated with the virtualization software, a ship’s network becomes agile and elastic while reducing overall energy consumption.

**KEYWORDS:** Virtual Technology, Cloud Computing, Thin Client, Consolidated Afloat Network Enterprise Services, Total Cost of Ownership, Energy Consumption, Ships Service Diesel Generator, Ships Service Gas Turbine, Generator

Framing tactics are used to structure a situation in an attempt to establish a “favorable climate” for influence. Framing can be used to influence the military or society to make decisions that are in your best interest (i.e. Jackie Robinson’s allowance into major league baseball and the desegregation of the armed services) by structuring the issues at hand. The military may be faced with several options; however, introducing social
influence tactics will alter his/her idea of what they believe to be their set course of action. Successful framing tactics are evident in how the military desegregated itself breaking from its long tradition of racial separation of decades past.

Framing will present the military an optional course of action. This course of action is not desirable for some, but most will benefit from it, due to the fact that homosexuals will not be subjugated, scrutinized, or discharged for their sexual orientation. The idea behind this framing tactic is to have the military choose option A on their own accord. This thesis will explore the relevance of the Jackie Robinson situation and how it relates to the current military actions towards “Don’t Ask Don’t Tell” and to determine how social influence tactics were employed to achieve the desired result. There are several examples ranging from desegregation of African-Americans into the military to the current acceptance of gays into the military.

**KEYWORDS:** Framing, Social Influence, Don’t Ask Don’t Tell, DADT, Cohesion, Negro Soldiers, Homosexuals, African-Americans
The effects of natural or man-made disasters in communications infrastructures can be so severe that immediately after the disaster, the emergency responders are unable to use them. In addition, some areas do not have any useful infrastructure at all. To bridge this gap in communications, a need exists for a reliable technology not dependent on the existing infrastructure.

This thesis focuses on first identifying the problem of communications gaps during natural or man-made disasters and reviewing the impact and potential benefit of implementing a solution based on the hastily formed networks (HFN) model. The research explores the different technological solutions to solve this problem by evaluating documentation for commercial, off-the-shelf technologies (COTS). Additionally, the thesis reviews the results of field experimentation conducted to evaluate the performance of these technologies in the field. The ultimate goal is to introduce the HFN concept as an enabler for the emergency response community (ERC).

Throughout this research, the focus revolves around testing COTS technologies. The research provides emergency responders with the background knowledge to make decisions on how to best bridge the gap of lack of communications under austere environments, and therefore, enable them to provide better response.

KEYWORDS: Emergency Response, Networks, Disaster, Recovery
no such model exists at present, our research attempts to pioneer and explore this concept and capability by exploring and providing an outline of an ICT assessment team model. In this thesis, we examine its potential structure, methodologies, and equipment, as well as discuss prospective funding sources, and include in the appendices, checklists derived from our findings, thus improving and hastening early responders’ understanding of a disaster’s communications situation.

KEYWORDS: Information and Communications Technology, Hastily Formed Network, Information Sharing Assessment, Disaster Relief, Disaster Zone Access

RIGHT TECHNOLOGY, RIGHT NOW: AN EVALUATION METHODOLOGY FOR RAPIDLY DEPLOYABLE INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN HUMANITARIAN ASSISTANCE/ DISASTER RELIEF
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Master of Science in Information Technology Management–March 2012
Co-Advisor: Brian Steckler, Department of Information Sciences
Co-Advisor: Gurminder Singh, Department of Computer Science

The most significant technological challenge after a major humanitarian disaster is the rapid deployment of information and communications technologies (ICT) for initial responders. Reliance on ICT—particularly wireless communications—is essential to a coordinated response, particularly in international disasters due to the large number and diversity of responding organizations. Therefore, choosing the most effective ICT systems for disaster response is a critical factor for ensuring success of the response effort. This research will provide background information related to selecting rapidly deployable ICT resources for disaster responders by exploring U.S. policy, worldwide disaster trends, and U.S. government responses. In addition, this thesis will evaluate ICT challenges that are unique to the post-disaster environment and identify essential characteristics of rapidly deployable ICT systems. Finally, this research will develop a quantifiable methodology based on essential characteristics to evaluate and compare commercially-available ICT systems in order to identify systems best suited for the disaster environment. Revelations will contribute to potential policy recommendations and follow-on research that will facilitate determination of the best ICT options, resulting in more effective cooperative utilization of these technologies to improve post-disaster responsiveness.

KEYWORDS: humanitarian assistance, disaster relief, information and communications technology, hastily formed networks, wireless communications

VIRTUAL DESKTOP INFRASTRUCTURES (VDIS) SUPPORTING AGILE SEABASING: A STUDY ON IMPROVING EMBARKABLE INTEGRATION ONBOARD AMPHIBIOUS FLAGSHIPS
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B.S., Naval Academy, 1999
John P. Becker–Lieutenant, United States Navy
B.S., The Citadel, 2005
Master of Science in Information Technology Management–March 2012
Advisor: Shelley Gallup, Department of Information Sciences
Second Reader: William J. Welch, Department of Information Sciences

Given the deliberate planning and effective practice of seabasing in support of the DoD’s broadening Range of Military Operations (ROMO), the U.S. Navy (USN) has found itself playing host to a litany of disparate organizations working together in highly dynamic environments. No USN platform is better suited to meet the challenge of organizational integration than our amphibious units. Designed for and well-practiced
in the embarkation, deployment, and debarkation of a two-thousand-strong Marine Expeditionary Unit (MEU), amphibious leadership and supporting personnel are still hindered by inefficient IT integration processes, hardware incompatibilities, and resulting security measures. Network integration for embarkable personnel and their deployed equipment has been identified as a priority requiring improvement. Changing institutionalized architectures and their supporting processes cannot deliver sufficient agility. Re-engineering calls for a technology insertion as well. Virtual Desktop Infrastructures (VDIs) may prove a viable option for enhanced interoperability onboard amphibious ships in the near future.

**KEYWORDS:** Seabasing, Amphibious, Information Technology, Marine Expeditionary Unit, Virtual Desktop Infrastructure, Embarkation, Re-engineering, Interoperability

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**BANDWIDTH MANAGEMENT IN RESOURCE CONSTRAINED NETWORKS**

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Hastily Formed Networks (HFNs) are typically deployed in resource constrained environments. Clients operating within HFNs have inadvertently utilized excessive bandwidth without user interaction. Our research focuses on managing bandwidth usage in resource constrained networks through the use of DNS Tampering, a method of content filtering. We evaluate two operating systems, Windows XP and Windows 7, and analyze how it may be possible to limit operating system updates utilizing DNS Tampering. We then explore how it may be possible to implement this technique utilizing equipment available for an HFN. Through our efforts, we develop and set forth specific methodologies that can provide the opportunity to limit bandwidth usage for specific applications in resource constrained networks.

**KEYWORDS:** Content Filtering, Hastily Formed Network (HFN), Network Management, Traffic Management, Bandwidth Management, Domain Name System (DNS), Domain Name Service (DNS)
THE EFFECT OF ADVANCED EDUCATION ON THE RETENTION AND THE PROMOTION OF SURFACE-WARFARE OFFICERS IN THE U.S. NAVY

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The goal of this thesis is to analyze the effect of advanced education on the retention and promotion of Navy surface warfare officers (SWOs). Multivariate probit models are used to estimate the effects of education, accession sources, demographic variables, and prior service status on retention and promotion.

The data set used in this study is obtained from the online Navy Econometric Modeling System (NEMS). It was constructed from annual snapshots of SWO officers in the Navy between 2000 and 2011. The data set includes 73,347 officer-year observations on 14,422 naval officers. We create cohorts based on the entry years of the officers and track their retention between the end of their initial service obligation (4 or 5 years), until the end of their tenth year of service. For the promotion analysis, we analyzed promotion to O-4 by the tenth year of service.

The retention analysis finds that master’s degree holders and first professional degree holders are more likely to remain in the Navy until ten years of service as compared to baccalaureate degree holders. The promotion analysis also finds that only master’s degree holders are more likely to be promoted compared to baccalaureate degree holders.

KEYWORDS: Education, Advanced Education, Retention, Promotion, Effect of Advanced Education, Probit, Heckprob, Heckman Selection Bias, SWO, Surface Warfare Officers, Biprobit, Bivariate Probit Model

THE EFFECTS OF COMBAT EXPOSURE ON THE MILITARY DIVORCE RATE

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This research investigates the effect that combat exposure has on the divorce rate for military personnel. The thesis uses demographic data from the Defense Manpower Data Center (DMDC) coupled with responses from the post-deployment health assessment (PDHA). The sample contains enlisted personnel from all four services who were married and deployed between 2001 and 2007. The probability of divorce after deployment was predicted using a probit model. Combat exposure is divided into two distinct categories, casualty experience and weapon usage. Casualty experience and weapon usage were used to create interaction terms with occupational specialties (combat arms, medical service, combat service, service support) and gender.

Results indicate that in most cases, combat exposure will increase the likelihood of divorce. Additionally,
a casualty experience tends to have a greater impact on divorce than does weapon usage. Specifically, weapon usage was found to increase the likelihood of divorce for personnel in the medical service (Navy) and service support (Army). A casualty experience increased the likelihood of divorce for personnel in combat arms (Marines, Army) and service support (Marines). Aside from combat exposure, the results indicate that divorce rates vary across occupational specialties and the likelihood of divorce is substantially higher for women.

**KEYWORDS:** Combat Exposure, Divorce, Probit Regression, PDHA, DMDC, AFHSC

**DEVELOPMENT OF A MARKOV MODEL FOR FORECASTING CONTINUATION RATES FOR ENLISTED PRIOR SERVICE AND NON-PRIOR SERVICE PERSONNEL IN THE SELECTIVE MARINE CORPS RESERVE (SMCR)**

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The purpose of this thesis is to develop a Markov model to determine the continuation rates for prior service and non-prior service enlisted population in the Selected Marine Corps Reserve (SMCR). Determining the end strength for these populations is necessary for reserve manpower planners to balance the force structure to minimize personnel overage or underages that impact training and labor costs, as well as career progression. The results of model validation indicate that models based on annual aggregate monthly transition rates fails the stationarity assumption required of Markov models. These results suggest that the attrition behaviors are seasonal for both enlisted populations leading to numerous states being non stationary in part due to their correlation with seasonality. We recommend developing and employing models with unique transition rates for each month.

**KEYWORDS:** Forecasting, Continuation rates, Manpower, Enlisted, Markov Model

**AN ANALYSIS OF PERSONAL AND PROFESSIONAL DEVELOPMENT IN THE UNITED STATES NAVY**

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Employee development is among the most important functions of any organization. Since employees are arguably an organization’s most important asset, organizations have an incentive to invest in, direct, and promote the development of their employees. As an organization, the U.S. Navy, too, provides for the personal and professional development of naval personnel.

This thesis reviews the Navy’s personal and professional development program and examines possible use of 360-degree feedback in the development of naval personnel. 360-degree feedback, also known as “multi-source or multi-rater” feedback, is a development tool that allows a person to receive feedback from his superiors, peers, subordinates, and in some cases, from internal and external customers.

The Royal Australian Navy and the U.S. Army have implemented 360-degree feedback programs. The U.S. Navy also has included 360-degree feedback initiatives as part of several training programs, and conducted a
360-degree pilot program. Evaluations of those 360-degree feedback initiatives have concluded that 360-degree feedback is beneficial to program participants. However, the Navy has yet to implement a Navy-wide 360-degree feedback program. This thesis concludes that implementing a 360-degree feedback program in the Navy would be a costly investment but one that will yield major benefits.

**KEYWORDS:** 360-Degree Feedback, IDP, Mentoring, Coaching, NFLEX, NCBC, NSLS, SMARTS-360, CPPD, Personal and Professional Development, Leader AZIMUTH Check, ALAFP, MSAF-360, IFR, New Generation Navy, LSI-360, Circumplex, PAP.

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**AN ANALYSIS OF THE MANPOWER IMPACT OF UNMANNED AERIAL VEHICLES ON SUBSURFACE PLATFORM**

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Currently the submarine force is exploring two possible UAVs: Switchblade and ScanEagle. Each brings capabilities to the submarine to allow safer operations while continuing to perform the required mission. The constantly changing operational environment has forced all elements of the military to adapt and overcome. The submarine force is tasked with more missions and less support than ever before. As a result the ability to adapt and overcome has create a need for additional capabilities in the form of unmanned aerial vehicles (UAVs).

A manpower analysis was conducted to identify requirements necessary for submarine launched UAV operations. Current surface launched UAV Navy Enlisted Classification (NEC) codes were used as a comparison for the analysis. Currently these NECs are only available to aviation source ratings. Analysis shows that there are several submarine specific ratings that have the same knowledge entry requirements as the aviation source ratings that are eligible to operate UAVs.

Furthermore, research showed that based on the simplicity of operation of Switchblade and ScanEagle, that no additional manpower requirements are necessary. Specifically, on all classes of submarines, Switchblade can be launched and flown with no additional watchstations manned, compared to a standard mission watchbill. Also, with ScanEagle, SSGN class submarines require no additional watchstanders once the UAV is launched, and airborne than would be required for a normal mission watchbill.

Incorporating UAVs into the arsenal of a submarine is a vital requirement that needs accomplished. This research recommends the creation of a specific NEC for the submarine force to identify UAV operators.

**KEYWORDS:** Unmanned Aerial Vehicles, UAV, Switchblade, ScanEagle, Manpower, Personnel, Training, and Manning, SSN, NEC, and SSGN

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**A COST-BENEFIT ANALYSIS OF FIRE SCOUT VERTICAL TAKEOFF AND LANDING TACTICAL, UNMANNED, AERIAL VEHICLE (VTUAV) OPERATOR ALTERNATIVES**

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A cultural debate exists to determine if the MQ-8B Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) should be operated by rated pilots, commissioned officers, or enlisted personnel. Each military service has historically treated this issue differently. The U.S. Navy currently requires rated pilots to fly Fire Scouts, the U.S. Army and Marine Corps allow enlisted personnel to fly their Shadow
Unmanned Aerial Vehicle (UAV), and the Air Force only allows rated pilots to fly their UAV systems. Technology has advanced rapidly in the area of UAVs as they have advanced from being remotely piloted aircraft to now being completely autonomous. This research examined the Air Vehicle Operator (AVO) requirements for autonomous vehicles such as Fire Scout and will demonstrate that the U.S. Navy should create a pilot program that trains enlisted personnel to operate Fire Scout.

This research identifies the costs and benefits associated with each type of prospective operator alternative—rated pilots, commissioned Surface Warfare Officers (SWO), and Operations Specialist (OS) enlisted personnel. By utilizing enlisted AVOs vice rated pilots, training costs will be found to be reduced from millions to tens of thousands, annual amortized manning costs will be cut by more than half, and total cost savings will be found to be on the order of a billion dollars over a ten-year period. The research will also identify both tangible and intangible benefits by allowing enlisted personnel to become Fire Scout AVOs. Benefits are identified relating to training time, manning constraints, physiological constraints, culture, and safety. Furthermore, this research will summarize current Knowledge, Skills, and Abilities (KSA) necessary to operate an autonomous air vehicle such as Fire Scout.

**KEYWORDS:** Fire Scout VTUAV, Air Vehicle Operator (AVO), Mission Payload Operator (MPO), Intelligence Surveillance Reconnaissance (ISR), Unmanned Aerial Vehicle (UAV), Unmanned Aerial System (UAS), Human Resources Cost Analysis Tool (HRCAT)

**UNIVERSITY STATES MARINE CORPS RESERVE FIRST-TERM ATTRACTION CHARACTERISTICS**

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This thesis examines the effect of attrition on USMCR NPS marines who enlisted with a 6X2 contract in FY 1994–2005. Three cohorts were established to determine if the events of September 11, 2001 had any impact on attrition rates with this population. The Pre-9/11 cohort enlisted in FY 1994–1995 and was used as a control group. The Overlap-9/11 cohort enlisted in FY 1996–2001, had no expectation of deployment but many did deploy in support of the Global War on Terrorism. The Post-9/11 cohort enlisted in FY 2002–2005 after 9/11 with full expectation to deploy.

The analysis included previous attrition studies, descriptive statistics, and two different probit regression models to determine the effects of various characteristics on attrition. The variables analyzed included deployment variables, demographics, education and aptitude variables, and regional areas.

The thesis found a decrease in attrition from the Pre-9/11 cohort to the Post-9/11 cohort. This was most likely caused by an increasing unemployment rate and deployments overseas. Deployments to combat areas decreased the probability of attrition. The other variables remained constant throughout the cohorts with predicted results. Overall, attrition is lower after 9/11 but as the economy improves and deployments decrease, attrition could return to Pre-9/11 levels.

**KEYWORDS:** Attrition Rate, Attrition, Retention, SMCR, Activation, Deployment, Mobilization, Marine Corps Reserve, USMCR, Probit Regression, Multivariate Analysis, Statistical Analysis, Non-Prior Service, Pre-9/11, Post-9/11
In a given fiscal year, the United States Marine Corps accesses approximately 30,000 enlisted personnel into its ranks. This labor supply of recruits is classified into various military occupational specialties (MOSs) according to the forecasted requirement for new personnel into a particular MOS. The classification plan is the primary initial training input into the training plan, which allocates all training resources for training and education command. The current classification model is based on a steady-state Markov model that estimates the first-term inventory of each initial training MOS inventory of personnel. A performance comparison was made against a transient Markov model that solves for an optimal classification plan over the course of a four-year planning horizon. First, the validity of the steady-state assumption is tested and found to produce a variance of annual targets for each MOS throughout the future years defense plan that is prohibitively high. Next, a comparison of each models’ ability to forecast annual attrition by MOS between the years 2001 and 2011 is tested. Results indicate that the transient model produced a more accurate forecast for 5,321 out of 7,379 design points (approximately 72% of the observations). The transient model achieved a Mean Absolute Proportional Error that was on average 14 percentage points smaller than that of the steady-state model. In over 25% of the cases, this difference exceeded 20 percentage points. Based upon this improved performance, it is recommended the Marine Corps adopt the enhanced transient Markov model as the foundation for forecasting its annual enlisted classification plan.

**KEYWORDS:** Loss Attrition, Classification Plan, Markov Model

This thesis analyzes the influence of advertising expenditure for ADF recruitment using data covering the period from June 2008 to December 2011. Econometric analysis was used to analyze the effect of media advertising on ADF enquiries, applications and enlistments. These models were developed to predict the impact of changing advertising expenditure on the generation of enquiries, applications and enlistments.

The econometric recruiting models included independent variables for total monthly ADF media expenditure, monthly enlistments targets, national monthly youth unemployment rates and quarterly propensity to enlist in the ADF. Advertising expenditure was found to be positively related to various measures of recruitment. Increasing advertising expenditure was found to generate enquires and applications. For example, a 10% increase in monthly advertising expenditure was found to increase enquiries by 1.6%. Similarly, a 10% increase in monthly advertising expenditure would increase applications by 1.3%. Youth national unemployment and enlistment targets were positively related to enlistments, while advertising expenditure was found to have no effect on enlistments.

**KEYWORDS:** Marketing and Advertising Expenditure, Recruitment
This thesis analyzes the training continuum for Navy recruiters coming from the fleet. Specifically, the study examines the current training pipeline and the theories of how people learn, why they learn, and how they retain information. The study focuses on the uniqueness of recruiting assignments, recruiter training requirements, the 2011 recruiting environment, the Navy Recruiting Command organization, and the influence of incentives on recruiting performance.

The training cycle for the main selling tool, Professional Selling Skills, is analyzed based on elements of learning, forgetting, and motivation. The purpose is to strengthen the training continuum and help mitigate potential recruiting difficulties in the years ahead. The primary sources of information are Navy Recruiting Command instructions and basic learning and motivational theories.

This study suggests ways to support the training continuum by ensuring that recruiters are provided with standardized and comprehensive training throughout their recruiting tour. Periodic refresher training would ultimately boost individual recruiter productivity as well as strengthen on-the-job training. In addition to reinforced training, new motivational factors and incentives can augment the training continuum. Recommendations are provided to improve the current training continuum with recruiting simulators and enhanced incentives.

**KEYWORDS:** Navy Recruiting, Training, Incentives, Recruiter Incentive, Freeman Plan, Bloom's taxonomy, Skill Decay, Professional Selling Skills (PSS), Motivation

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**STUDY OF PERSONNEL ATTRITION AND REVOCATION WITHIN U.S. MARINE CORPS AIR TRAFFIC CONTROL SPECIALTIES**

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This thesis evaluates U.S. Marine Corps Air Traffic Control (MATC) military occupational specialties (MOSs) to determine methods of reducing personnel attrition from the MATC Basic Course and revocation from operational forces. The author analyzes Marine Corps personnel data obtained from the Total Force Data Warehouse and Headquarters Marine Corps. The range of the data analyzed covers a period from fiscal years 1999 through 2008, including 965 MATC Marines. Multivariate regression models are estimated to determine the effects of AFQT score, ASVAB composite scores, demographics, and other measures of performance on the likelihood of personnel attrition and revocation. Results indicate that changing selection criteria for AFQT score or ASVAB composite scores is not warranted. It is recommended that current selection criteria be augmented with improved medical screening at Military Entrance Processing Stations (MEPS) and recruit depots, to include non-cognitive testing, such as Navy Computer Adaptive Personality Scales (NCAPS), during recruitment. It is also recommended that an economic analysis be conducted comparing the cost of personnel losses during training with the cost of losses due to revocation.

**KEYWORDS:** Marine Corps, Air Traffic Control, ATC, Marine Corps Air Traffic Control, MATC, Attrition, Revocation, Selection, MOS, Regression, Probit, dProbit, STATA, Statistics, Marginal Effects, ASVAB,
The recent financial crisis that Greece (Hellas) has suffered has restricted and reduced the budgets of many public organizations. Among those, the Hellenic ministry of defense is examining ways to reduce costs while maintaining operational readiness. The first area being examined is retirement legislation. Variables such as years of service required to receive a pension, years of service by pay grade, and skills officers should possess to be promoted were examined and recorded in ordinances (directives) issued by the president of the Hellenic Republic.

However, the implementation of the ordinances is expected to expand the number of officers in the middle pay grades. In an attempt to deal with potential personnel inflation in the middle and higher pay grades, the Hellenic Ministry of Defense is studying an alternative plan of two parallel officer inventories: war and auxiliary. The primary inventory will consist of war officers. These are very capable individuals, considered top performers, and their career stops at the pay grade of flag officers. The auxiliary inventory includes those officers with lower performance with a terminal pay grade of captain. The purpose of these parallel inventories is to ensure all officers serve 35 years in order to receive a full pension.

This thesis analyzes job performance from the perspective of experience, ability (performance), motivation, and possession of advanced degrees. It concludes that experience should be combined with level of education for a reliable field of evaluation. Through the use of weighting, in terms of the priorities that the Hellenic navy should establish in every category of officer evaluation, the thesis turns job performance into a single number, or score. Thus, top performers are distinguished from officers with lower scores on job performance. With Markov-chain models and officer scores on job performance, the war and auxiliary inventories emerge. The war inventory is then adjusted to corresponding billets in every pay grade within a period of five years. The pool of auxiliary officers controls for potential future deficiencies in the war inventory.

**KEYWORDS:** Hellenic Navy, Officer’s War Chain of Command, Officer’s Auxiliary Chain of Command, Individual Performance, Markov Chains Models, Performance Range (PR), Promotion Policy

**APPLICATION OF A UNIFORM-PRICE, QUALITY-ADJUSTED DISCOUNT AUCTION FOR ASSIGNING SURFACE WARFARE OFFICER RETENTION BONUSES**

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This thesis analyzes the potential benefits of implementing a unique auction model that provides community and compensation managers with the ability to control for the quality and quantity of sailors retained. The study utilizes survey data to estimate officers’ preference parameters and compare the cost, quantity and quality of surface-warfare officers (SWO) retained by the current SWO bonus, a standard uniform-price auction, and a quality-adjusted discount (QUAD) auction.

The results demonstrate efficiency improvements over the current retention system. The thesis supports the findings from previous research on QUAD auctions, and confirms the hypothesis that increases in quality
do not necessarily create cost increases.

Findings from this thesis can be used in future retention and compensation policies to more cost effectively shape the force while maintaining or enhancing quality.

**KEYWORDS:** Surface Warfare Officer, Officer Retention, Auctions, QUAD, Quality, SWOCPS, SWO Bonus

**AN ANALYSIS OF SAILORS’ ACADEMIC SUCCESS IN THE NAVY COLLEGE PROGRAM DISTANCE LEARNING PARTNERSHIP (NCPDLP) SCHOOLS**

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This thesis analyzes the Sailors’ academic success in the TA-funded courses taken in the Navy College Program Distance Learning Partnership (NCPDLP) Program partner institutions. This study also investigates the effect of institutional characteristics on the academic success of students. The data files obtained from Navy Education and Training Command (NETC) and Integrated Postsecondary Education Data System are merged to generate the data set used in the analysis. The analysis suggests that Sailors who take courses via Distance Learning (DL) methods in the NCPDLP partner schools have lower course completion rates and lower grade point averages than Sailors who take DL courses in other types of schools. The analysis also indicates that Sailors who enroll in private for-profit schools receive higher grades in TA-funded courses than Sailors who enroll in public or private nonprofit schools.

**KEYWORDS:** Distance Learning (DL), Navy College Program Distance Learning Participation (NCPDLP), Tuition Assistance (TA), Method Of Instruction

**RETENTION OF U.S. NAVY SURFACE WARFARE OFFICERS BEFORE AND AFTER THE GLOBAL WAR ON TERRORISM**

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This thesis analyzes the effects of the global war on terrorism (GWOT) on the retention of Navy surface-warfare officers. Multivariate probit models are used to estimate the effects of commissioning source and other demographic variables on retention. The analysis data set was based on archival data provided by the Navy via the Navy Econometric Modeling System (NEMS). The data set contained information on Navy surface-warfare officers in pay grades O2–O6. The archival data set included 73,348 records. In order to analyze the effect of the GWOT on officer retention, we created entry cohorts and analyzed retention to the sixth year in their careers. We analyzed retention before and after the start of the global war on terrorism.

Our retention analysis shows that Naval Academy and NROTC graduates are less likely to stay than OCS graduates during both the pre- and post-GWOT periods. Officers with advanced education are less likely to stay than officers with bachelor's degrees in the pre-GWOT period but, in the post-GWOT period, those with advanced education are more likely to stay. We conclude that the GWOT was a significant factor affecting the retention decisions of Navy surface-warfare officers, as overall retention fell for officers making retention decisions in the post-GWOT period.
MANAGEMENT

**KEYWORDS:** Global War on Terror, GWOT, Retention, Effect of Commissioning Source, Probit, Surface Warfare Naval Officers

**A QUALITATIVE ANALYSIS OF NAVY FUNDED GRADUATE EDUCATION IN MEETING HR SUBSPECIALTY BILLET KNOWLEDGE REQUIREMENTS**

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This research examines how effectively the Navy is meeting its goal of preparing HR officers with the necessary education to meet the demands of subspecialty (SSP) coded billets through its resident funded graduate education programs at Naval Postgraduate School (NPS). A comparative mapping analysis is used to determine the degree of likeness between billet knowledge requirements, represented by Navy Officer Billet Classifications (NOBCs), and Education Skill Requirements (ESRs) that form the basis of these graduate curricula. A December 2011 data set was used to examine all 3111, 3130, 3211, 4600, and 6201-coded HR billets that are sourced by resident funded graduate education (Financial Management, Manpower Systems Analysis, Operations Analysis, Human Systems Integration, and Information Systems and Technology respectively).

The research concludes that the Navy is effectively achieving its educational goal for HR officers attending NPS. Recommendations include continued billet management and an in-depth needs analysis by activity in lieu of NOBC mapping, to maintain and address emerging requirements in the fleet.

**KEYWORDS:** Financial Management, Manpower Systems Analysis, Operations Analysis, Human Systems Integration, Information Systems and Technology, NOBC, ESR, SSP, 1200 Billets, 1207 Billets, 3130, 3111, 3211, 4600, 6201, Navy Human Resources.

**MANPOWER ISSUES INVOLVING VISIT, BOARD, SEARCH, AND SEIZURE (VBSS)**

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Nearly all cruiser destroyer (CRUDES) ships deploy through potential piracy areas in the five-million square mile Fifth Fleet domain, which is why all Navy warships maintain Visit, Board, Search, and Seizure (VBSS) shipboard teams. This research analyzed advantages and disadvantages of the VBSS structure including alternative approaches to how the Navy could train, certify and deploy VBSS teams, e.g., Fifth Fleet detachments. Ship’s company VBSS teams face an unattractive tradeoff during deployment concentrate on Navy Enlisted Code (NEC) and ratings training, and prioritize VBSS team-training. School-house training and certification are crucial yet insufficient for maintaining team-performance in accordance with required occupational capabilities (ROC) requirements. Using VBSS detachments would reduce the total number of personnel needed to accomplish the VBSS mission. If converting to detachments is improbable, then Navy Commanding Officers could better support their VBSS mission by prioritizing team training before and during deployment. US Marines, already well-trained and embarked on amphibious ships could also accomplish this mission.

**KEYWORDS:** VBSS, MIO, Manpower, SMD, Navy, ROC/POE, LEDET, MESF, SRF, Boarding
This study examines factors affecting promotion of Navy nurses from 2001 to 2010. The objective of the study is to identify important service and educational factors that affect promotion in a wartime environment. The study finds that deployment increases the probability of promotion to lieutenant commander, but does not have a significant effect on promotion to commander or captain. Other factors affecting promotion to lieutenant commander are critical wartime specialties and highest education in nursing. For lieutenants, in addition to these factors, experience serving in a variety of locations positively affected promotion to lieutenant commander. As expected, advanced degrees positively affect the probability of promotion to commander and captain, while overseas assignments appear to have a negative impact on promotion to commander. The study also finds that being a nurse practitioner or certified registered nurse anesthetist positively affects promotion across all ranks. Gender does not appear to be a significant determinant of promotion in any of the models.

**KEYWORDS:** Nurse, Promotion, Officer, Deployment, War, Controlled Grade, Lieutenant, Lieutenant Commander, Captain, Education, Nurse Practitioner, Certified Registered Nurse Anesthetist, Retention

The purpose of this thesis is to examine career progression for ground combat arms officers in the Marine Corps Reserve, and to identify gaps between current and optimal career progression. Recent policy changes provide the catalyst for this thesis. On 4 December 2006, the Marine Corps announced the implementation of the Officer Candidate Course-Reserve. At the time, active component manpower practices and historically high retention rates resulted in reduced numbers of officers leaving active duty following their initial service obligation. Those officers who transitioned into the reserve component did so at grades more senior than required to fill junior officer billets. These factors combined to create a gap between RC junior company grade leadership requirements and the inventory of junior company grade officers. As the Marine Corps begins to staff reserve ground combat arms and engineer platoon and company commanders at 100% of manning, the requirement exists to develop a career path that provides the breadth of experience and expertise desired in its future leaders. However, challenges arise regarding the early to mid-stages of career progression due to training opportunities and PME requirements being less readily available to reserve officers than to their active component counterparts.

**KEYWORDS:** Career, Optimal, Progression, Reserve, Officer, Promotion, Command
This study estimates and compares the retention rates of the various recruitment programs for the Navy’s Medical Corps officers. The study is designed to analyze whether current accession plans yield adequate retention rates to maintain the long-term viability of the Medical Corps. The data included 3,568 Medical Corps officers who accessed into the Navy between 1996 and 2006. For the purposes of this study, retention is defined as an officer staying one year past their initial minimum service obligation. Our results indicate that medical officers accessed via the Uniformed Services University of the Health Sciences and Direct Accession programs have higher retention rates compared to officers from the Armed Forces Health Professions Scholarship programs. These results hold true for female, male, and minority Medical Corps officers. Further research is recommended to fully quantify the cost of each accession program and their benefits on long- and short-term retention.

**KEYWORDS:** Manpower/Supply, Retention, Recruiting, Personnel/Attrition, Manpower Policy Issues, Requirements/Determination, Distribution
Cryogenic milling was studied for the ex situ strengthening of aluminum (Al) with carbon nanotubes (CNT). Characterization of mechanically alloyed Al-CNT powders was conducted in preparation for bulk powder processing to be used in cold spray. Al-CNT metal matrix composite powders with 5 wt.% and 10 wt.% CNT were synthesized by cryogenic milling of the blended component powders. Stearic acid was used as a process control agent to minimize agglomeration of the powders upon milling. CNT reinforcement of the Al powder was successfully obtained while maintaining CNT structure after milling the powders for periods ranging between six and 90 minutes using a SPEX 6870 Freezer/Mill. Composition and properties of the Al-CNT composite was studied using X-ray diffraction, optical microscopy, nanoindentation, scanning electron microscopy (SEM), Raman spectroscopy, and laser diffraction particle size analysis.

KEYWORDS: Aluminum, Carbon Nanotube, Composite, Cryogenic Milling, Mechanical Alloying, Metal Matrix

The thesis addressed the control system development for a high-speed surface vessel. In particular, the work utilized modern adaptive control techniques to design a speed following controller for the SeaFox ASV; the vehicle features three distinct speed regimes including the displacement, rapid transition and planing regimes. The study started with the collection of experimental data required to characterize the operating modes and the inherent nonlinear phenomena of the high-speed ASV. Then, it proceeded to system identification study with an objective to develop a mathematical model of the vehicle thus aiming to represent the ASV’s speed dynamics at various regimes and to facilitate control system development. After completing the model development, three speed following controllers were designed: A classical Proportional-Integral-Derivative (PID), a nonlinear Model Reference Adaptive (MRAC) and a $L_1$ Adaptive Controller. The motivation behind the choice of three different controllers is twofold. First, comparison of the linear and nonlinear control approaches is desired to better illustrate the achievable control architecture limitations. Second, comparing two types of nonlinear adaptive control architectures allowed the selection of the best control algorithm for oper-
ating the ASV speed in the presence of highly non-linear dynamics and significant disturbances acting on it. Furthermore, each controller is integrated with the SeaFox mathematical model and implemented with and without realistic operational disturbances. This provided a basis for objective comparison among the controllers and gave a means to demonstrate their relative robustness and performance characteristics. Finally, the MRAC and the PID controller were implemented onboard the actual SeaFox ASV and tested in numerous sea-trials under natural conditions to once again demonstrate the advantages and limitations of the chosen control architectures.

**KEYWORDS:** Autonomous, Unmanned, Surface, Vehicle, USV, Control, Throttle, SeaFox, Modeling, Controller, PID, MRAC, L1, ASV, Adaptive

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**COORDINATION AND CONTROL FOR MULTI-QUADROTOR UAV MISSIONS**  
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Master of Science in Mechanical Engineering-March 2012  
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Second Reader: Noel Du Toit, Department of Mechanical and Aerospace Engineering

This thesis is centered upon an optimal trajectory generation algorithm that allows real-time control for cooperation of multiple quadrotor vehicles for intelligence, surveillance, and reconnaissance missions with minimal user input. The algorithm is designed for an indoor environment where global positioning system data is unavailable or unreliable, forcing the vehicles to obtain position data using other sensors. This thesis specifies the lab setup and well as the control approach used. Data acquired from two experiments is included to demonstrate the effectiveness of the control approach.

The control approach described within allows for a fully autonomous system with user input required only at the initiation of a mission. The algorithm blends trajectory planning, trajectory following, and multi-vehicle coordination to achieve the goal of autonomy. The focus of the thesis was on trajectory generation and multi-vehicle coordination, while leveraging existing trajectory following controller implementations. The trajectory generation is accomplished with a direct transcription of the optimization problem that leverages inverse dynamics and separates spatial and temporal planning. The vehicle motion is constrained, and simplifying multi-vehicle coordination assumptions allow for the efficient solution and execution of the problem.

**KEYWORDS:** Quadrotor, Cooperation, Quanser, LQR, Direct Methods, Trajectory Generation, Trajectory Following, Optimization, Inverse Dynamics, IDVD.

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**DIFFUSION COUPLE ALLOYING OF REFRACTORY METALS IN AUSTENITIC AND FERRITIC/MARTENSITIC STEELS**  
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This thesis utilized the diffusion couple approach to evaluate the addition of molybdenum, niobium, tantalum, and tungsten to 316 stainless (316SS) and alloy HT9 steels. Refractory elements have been previously studied as alloying candidates to mitigate problems such as radiation-induced segregation, void swelling, and irradiation creep in reactor steels. Diffusion couples were characterized via energy dispersive x-ray spectroscopy (EDS) and nanoindentation to examine refractory element solubility, diffusivity, and the effects these elements have on hardness and elastic modulus in 316SS and alloy HT9. Molybdenum and tungsten samples showed significantly higher solubility and diffusivity than niobium and tantalum, with evidence of multiphase
regions several hundred microns from the diffusion couple interface. Nanoindentation revealed evidence of hardening as a function of increasing concentration for some, but not all of the refractory elements. Diffusion of the refractory elements in alloy HT9 was significantly higher than in 316SS, which suggests that alloy HT9 retained its ferritic structure even at high temperatures, i.e. 1100 °C.

**KEYWORDS:** Refractory elements, diffusion couple, nuclear, alloy 316SS, alloy HT9, Mo, Nb, Ta, W

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**DEVELOPMENT AND ANALYSIS OF A BIDIRECTIONAL TIDAL TURBINE**

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The concept of using renewable energy for power generation has experienced much attention with increasing costs of non-renewable sources. The largest untapped renewable energy resource was in the form of the oceans and currents created by them. It has been proven that many different concepts and designs are possible for this use and this study will focus on a bi-directional turbine created for this purpose.

In the present study, the commercial CFD software ANSYS CFX was utilized to build a turbine map. The basic turbine map was developed for a 25 blade biaxial turbine under various flow conditions and the optimal efficiency for each flow condition was determined and a further analysis of the number of blades in the rotor was completed. The flow diagrams produced by the CFD analysis show that many improvements can still be made to the design in future iterations.

**KEYWORDS:** Cross-Flow, Tidal Turbine, Renewable Energy, Green Energy

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**FABRICATION AND OPTIMIZATION OF CARBON NANOMATERIAL-BASED LITHIUM-ION BATTERY ANODES**

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Second Reader: Joseph Farmer, Lawrence Livermore National Laboratory

Lithium-ion batteries possess high energy and power densities, making them ideal candidates for energy storage requirements in various military applications. Commercially produced lithium-ion battery anodes are commonly graphitic carbon-based. However, graphitic carbons are limited in surface area and possess slow intercalation kinetics. The energy and power density demands of future technologies require improved lithium-ion battery performance.

Carbon nanomaterials, such as carbide-derived carbons, carbon onions and carbon nanotubes, used in lithium-ion battery electrodes can exhibit a much higher specific capacity (up to 1000 mAh/g) and faster charge/discharge characteristics than their graphitic carbon counterpart, which has a specific capacity of 372 mAh/g. However, little is known about how certain characteristics, such as structure and surface chemistry, for example, of carbon nanomaterials affect the electrochemical performance of lithium-ion batteries. Further investigation is necessary to fully understand the governing storage mechanism. A comprehensive analysis of the electrochemical performance of new anode materials, which includes a wide range of tests, requires the ability to fabricate a large number of electrodes and batteries of nearly identical quality. Thus, the optimization of the individual cell production steps is a crucial requirement for a comprehensive study of the electrochemical properties of new anode materials and is central to this research.
EFFECTS OF CARBON NANOMATERIAL REINFORCEMENT ON COMPOSITE JOINTS UNDER CYCLIC AND IMPACT LOADING

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Second Reader: Randall D. Pollak, DoD Civilian

This study investigated the influence of Multi-Walled Carbon Nanotubes (MWCNTs) and Carbon Nano-fibers (CNFs) reinforcement on the behavior of Carbon Fiber Reinforced Polymer (CFRP) joint interface under cyclic and impact loading. Test coupons with pre-cracks were fabricated via Vacuum Assisted Resin Transfer Molding (VARTM) technique with 7.5g/m2 of MWCNTs or CNFs dispersed at the joint interface ahead of the crack tip. The test coupons were loaded in 3-point bending at 2Hz and 10Hz frequencies for the cyclic loading test. The CNTs and CNFs-reinforced samples displayed higher stiffness and had significantly shorter crack propagation lengths under the same loading cycles. Resistance to crack propagation was evident in the reinforced samples as observed using an optical microscope. Similar sets of reinforced as well as non-reinforced samples were subjected to low energy impact tests and their dynamic responses and failures were also compared. CNTs-reinforcement samples experienced failure at higher impact force as compared to non-reinforced samples. However, further testing was recommended to establish the effects of CNFs reinforcement under impact loading. The test results suggested that proper reinforcement of the joint interface using carbon nanomaterial can significantly delay the crack growth, resulting in improvement of composite structural integrity and its service life.

KEYWORDS: Carbon NanoTubes, Carbon NanoFibers, composite adhesive joint, Carbon Fiber Reinforced Polymer, cyclic loading, impact loading

AUTONOMOUS UNDERWATER VEHICLE PLANNING FOR INFORMATION EXPLOITATION

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The ability of an Autonomous Underwater Vehicle (AUV) to dynamically plan safe routes and maneuvers in dangerous environments is directly relevant for the future of the use of AUVs in the exploration and exploitation of the underwater environment, specifically the littorals and inland waters. This thesis builds upon the existing body of knowledge of the REMUS AUV dynamics and kinematics and develops a control scheme for a real-time optimized vehicle trajectory that will permit continuous and autonomous collection and exploitation of external sensor data, which will facilitate full 360-degree, 2-dimensional mapping of the underwater environment surrounding the vehicle while preventing the vehicle from coming into contact with mapped objects in the water. The developed control schema will seek to generate a trajectory in real-time that optimizes a key parameter of interest, the Information Gain, while minimizing a specified cost function of constraints, such as kinematic limits and obstacle avoidance criteria.

KEYWORDS: Autonomous Underwater Vehicles, Path Planning, Information Optimization, Information Gain, Controls
This thesis describes the microstructural and mechanical property changes associated with friction-stir processing (FSP) of HY-80 steel under dry and underwater conditions. HY-80 is a low-carbon alloy steel that is used in a quenched and tempered condition and is highly susceptible to hydrogen assisted cracking associated with conventional fusion welding. FSW/P (400 RPM/2 IPM) was conducted using a polycrystalline cubic boron nitride tool having a pin length of 6.35 mm. Two sets of processing runs were completed on HY-80 plates, 6.35 mm in thickness, one dry and the other under seawater. Analysis of the residual hydrogen content revealed little change in hydrogen content associated with FSW/P. Detailed microstructural characterization (optical and scanning electron microscopy) with emphasis on the differences in the distribution of constituent phases in the rolling, transverse and normal planes was carried out. Microstructural analysis of the “plan-view” section at the tool extraction sites of FSW/P samples was executed. Mechanical properties of these samples were evaluated by tensile, microhardness, and Charpy V-notch impact resistance tests. The results indicated that austenitization occurred within the stir zones and subsequent cooling influenced the final microstructure and properties. The thermomechanically affected zone displayed a gradual change in near-equiaxed austenitic grain size towards both the tool axis as well as the base plate with little grain shape change throughout. These results have been rationalized on the basis of expected temperature and deformation fields generated setup in these steel samples and the nature of phase transformations occurring in low carbon steels such as HY-80.
Observation network design requires some framework for sensitivity studies. The goal is to place observations where they will reduce forecast error the most. We use uncertainty estimates from our best forecast models as an indicator of forecast error. The first step is then to find initial-state perturbations that reduce forecast uncertainty by minimizing a user-dependent norm. Adjoint models have helped meet this challenge for decades. More recently, ensemble sensitivities have emerged as a powerful alternative to adjoint models. Under the conditions of Gaussian statistics and an infinite ensemble, lagged covariances from an ensemble can be used equivalently to an adjoint model to give the least-squares minimization of a given cost function. One practical advantage is that costly development and maintenance of tangent linear and adjoint models are avoided. Ensemble sensitivities have been shown to be an effective alternative to adjoint models. They have been used successfully to diagnose predictors of forecast error in synoptic storms, extratropical transition and developing hurricanes. Because they rely on lagged covariances from a finite-sized ensemble, they are subject to sampling error and spurious covariances. However, their efficacy for high-resolution forecasts in mountainous environments has not been thoroughly explored. We present results from experiments designed to establish the potential for ensemble sensitivity computations with a high resolution mesoscale model (grid spacing 4 km) in complex terrain. Using the Weather Research and Forecast (WRF) model and the Data Assimilation Research Testbed (DART) we compute sensitivities with cost functions defined to emphasize parameters affecting fog forecasting in the boundary layer. High sensitivities are interpreted as indicating low predictability for forecasting in the mountains. Results from convergence studies reveal the ensemble sizes needed to robustly estimate the sensitivities. We comment on the implications of results for observation placement and on the expected impact of model inadequacy.

**KEYWORDS:** Mesoscale Ensemble Sensitivity Analysis, Ensemble Sensitivities, Mesoscale Forecast Sensitivities, Observation Network Design, ESA
Ocean (NIO) is conducted. The relationships between ENSO and IOD are compared. Statistical analysis reveals a relationship exists. Each oscillation is examined to measure its statistical significance to TC activity in the NIO. The statistical examination was performed on the phases of each oscillation singularly and then all possible phase combinations of the three oscillations occurring concurrently. Analysis through combining concurrent occurrences of climatic oscillations indicates an increased statistical significance to TC activity in the NIO.

**KEYWORDS:** Tropical Cyclones, Climatology, Madden-Julian Oscillation, Indian Ocean Dipole, El Nino-Southern Oscillation

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**A MESOSCALE MODEL ANALYSIS OF SEA-FOG FORMATION AND DISSIPATION NEAR KUNSAN AIR BASE**

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Co-Advisor: Shouping Wang, Naval Research Laboratory
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This research used the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) to examine the physical processes affecting sea fog development near Kunsan AB. The simulated sea fog event occurred from 30 March to 02 April 2011 and was validated using observations. Model results were analyzed from three perspectives. A trajectory analysis examined the evolution of the wind, air-sea interaction, and thermodynamic properties of the air column prior to the sea fog formation; a time variation of similar properties at fixed locations investigated the evolution of the fog for the entire life cycle of the fog event; and a vertical cross-section through Kunsan AB revealed the spatial variability and the effects of coastal circulations. Finally, evaluation of a current forecast tool, fog stability index (FSI), was conducted to determine its adequacy.

Results from this analysis indicated strong influence of the adjacent sea on the fog development and maintenance at Kunsan AB. For the fog event studied in this research, fog initially developed as nocturnal fog over land, but was later maintained by advection from the sea. Strong cooling within the fog layer was present resulting in significant surface-air temperature difference, likely associated with radiation cooling. Radiative cooling, however, did not result in turbulent mixing due to the shallowness of the fog layer and the stable thermal stratification. The presence of the fog layer along the coast appeared to modify the coastal circulation, which was also an important component in introducing moisture into Kunsan AB for fog formation/maintenance. Dissipation of the fog was dominated by synoptic changes. A modified version of FSI is suggested based on results from this study.

**KEYWORDS:** Sea fog forecasting, Fog Stability Index, back trajectory analysis, spatial variability, time series analysis, Kunsan AB, and COAMPS mesoscale model

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**A STATISTICAL MULTIMODEL ENSEMBLE APPROACH TO IMPROVING LONG-RANGE FORECASTING IN PAKISTAN**

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We have designed, developed, and tested a method for generating long-range forecasting systems for predicting environmental conditions at intraseasonal to seasonal lead times (lead times of several weeks to several
The resulting systems use statistical, multimodel, and lagged average ensemble approaches. The ensemble members are generated by multiple regression models that relate globally distributed oceanic and atmospheric predictors to local predictands. The predictands are three tercile categorical forecast targets. The predictors are selected based on their long-lead correlations to the predictands. The models are selected based on their lagged average ensemble skill at multiple leads determined from cross-validated, multidecadal hindcasts. The main system outputs are probabilistic long-lead forecasts, and corresponding quantitative assessments of forecast uncertainty and confidence. Our forecast system development process shows a high potential for meeting a wide range of military and national intelligence requirements for operational long-lead forecast support.

The main testbed for our system development was long-range forecasting of environmental conditions in Pakistan. This problem was selected based on DoD and national intelligence priorities for long-range support. For this test case, the system uses 81 ensemble forecast members that predict the probability of summer precipitation rates in north-central Pakistan up to six months in advance. The cross-validated hindcast results from the test case system are substantially more skillful than reference climatological forecasts at all leads. The test results also show that the combination of multiple forecast member predictions in a multimodel, lagged average ensemble approach yields more accurate forecasts than any one forecast member individually.

**KEYWORDS:** Pakistan, Precipitation, Climate, Climate Variations, Anomalies, Prediction, Arctic Oscillation, El Nino, La Nina, Teleconnection, Long-Range, Statistical Forecast, Ensemble, Lagged Average Ensemble, Probabilistic Forecast, Multimodel, Meteorology, Decision Analysis, Quantitative Confidence Aid

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**NOWCASTING HAIL SIZE FOR NON-SUPERCCELL THUNDERSTORMS IN THE NORTHEASTERN U. S.**

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Hail size prediction is a difficult task for meteorologists. The most recent method used by the United States Air Force after thunderstorm initiation involves identifying the amount of storm-top divergence and correlating that value to the height of the freezing level. However this method was based on a study that looked at both supercell and multicell thunderstorms alike. This paper attempts to build off this previous study, although solely looking at non-supercell thunderstorms based on the hypothesis that due to dynamic differences between the storm types, common indicators found in both are not indicative that hail of similar size will be produced.

**KEYWORDS:** Freezing Level, Hail Size, Non-Supercell Thunderstorms, Northeastern U.S., Storm-top Divergence

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**POTENTIAL VORTICITY STREAMERS AS PRECURSORS TO TROPICAL CYCLONE GENESIS IN THE WESTERN PACIFIC**

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The term tropical transition (TT) is used to describe the formation of a tropical cyclone from an extratropical precursor. The overarching goal of this thesis is to re-examine TT in the western North Pacific. This is accomplished via the synthesis of a subjective climatology of all tropical cyclones (TCs) from 2002–2008 and a
case study analysis of ensemble prediction data for the particularly intriguing event of TS 16W in September of 2008.

The climatological analysis indicated that TT events represented 14% of all TCs during the study period. The maximum frequency of TT events occurred in the late summer / early fall. The resulting storm systems tended to form farther to the north than non-TT events and were found to be relatively weak and short-lived. The results of the case study analysis lend credence to the earlier finding that the genesis pathway of TS 16W exhibited a two-stage evolution. The first stage involved the forcing of near-continuous deep convection by a tropopause-level potential vorticity (PV) anomaly. The second stage involved the rearrangement of the upper-level PV structure via diabatic processes, resulting in a necessary reduction of vertical wind shear.

**KEYWORDS:** Tropical Cyclones, Tropical Cyclogenesis, Potential Vorticity, Tropical Transition

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**CLOUD CLIMATOLOGIES FOR ROCKET-TRIGGERED LIGHTNING FROM LAUNCHES AT CAPE CANAVERAL AIR FORCE STATION AND KENNEDY SPACE CENTER**

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Co-Advisor: Col Andrew P. Boerlage, USAF (ret)

We have conducted a study on the development of detailed climatological probabilities of violating cloud-related Lightning Launch Commit Criteria (LLCC) used by Cape Canaveral Air Force Station and Kennedy Space Center (CCAFS and KSC). This study was conducted to provide the 45th Weather Squadron with improved capabilities for operational forecasting for launches from CCAFS and KSC. Our focus was on developing methods to produce climatological probabilities of violating one of the LLCC, the thick cloud layer rule. We developed a hybrid process of blending data from the Climate Forecast System Reanalysis (CFSR), meteorological aerodrome reports (METARs), radiosonde observations (RAOBs), and expert meteorologist data sets to create a merged data set for determining the probability of violating the thick cloud layer rule.

Using our blended hybrid process, we computed cloud thicknesses, and probabilities of violating the thick cloud LLCC for each day of the year at 00Z and 12Z. Additionally, we conducted a sensitivity analysis to identify the potential for modifying the thick cloud LLCC. A primary result from our study is a sub-daily data set of the climatological probabilities of violating the thick cloud layer rule. We conducted eight validation case studies that demonstrated our calculated violations match well with observed violations. The development of a merged data set that provides more useful information than any one of the individual data sets is a technique that is likely to be useful in solving many other climatological problems.

**KEYWORDS:** Cape Canaveral, Climate Forecast System Reanalysis, Cloud Climatologies, Kennedy Space Center, Lightning Launch Commit Criteria, Rocket Triggered Lightning, Thick Cloud

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**ANALYSIS OF SFMR-DERIVED AND SATELLITE-BASED RAIN RATES OVER THE TROPICAL WESTERN NORTH PACIFIC**

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Aircraft-derived rain rates are obtained from the Stepped Frequency Microwave Radiometer (SFMR) operated on WC-130J in tropical cyclones over the western North Pacific during the Tropical Cyclone Structure 2008 (TCS-08) program and the Impact of Typhoons on the Ocean in the Pacific (ITOP) 2010 program.
Rain rates from SFMR are compared to rain rates from the Advanced Microwave Scanning Radiometer–EOS (ASMR-E) and the Tropical Rainfall Measuring Mission (TRMM) satellites when the passes occurred within plus-or-minus three hours of the aircraft times. The relative frequency distributions of SFMR-derived rain rates matched the distribution of AMSR-E rain rates over low- to medium rain rates. However, rain rates over 10 mm h⁻¹ occurred more frequently in the satellite-based values. Because of the difference between SFMR and AMSR-E rain rates over medium intensities, the two rain rate distributions are found to be statistically different. Similar differences were found in comparisons between SFMR and the TRMM Microwave Imager (TMI)-based rain rates, and in comparisons between TMI and AMSR-E rain rates. Differences between the relative frequencies of rain rates larger than 10 mm h⁻¹ resulted in the conclusion that the distributions of SFMR and TMI frequency distributions and AMSR-E and TMI are statistically different.

**KEYWORDS:** Tropical Cyclone, Satellite Reconnaissance, Aircraft Reconnaissance, TCS-08, ITOP 2010, Western North Pacific Typhoons, SFMR, AMSR-E, TRMM, Rain Rates

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**EVALUATION OF NON-CONVEXTIVE WIND FORECASTING METHODS IN THE 15TH OPERATIONAL WEATHER SQUADRON AREA OF RESPONSIBILITY**

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Predicting critical wind thresholds for non-convective wind events is a challenge for today’s operational forecasters. This study evaluates two different methods to forecasting non-convective wind gusts of ≥35 knots at five locations within the 15th Operational Weather Squadron’s area of responsibility. In 2001, Olivier Brasseur developed the Wind Gust Estimate (WGE) as a physically based representation of the boundary layer parameters required to produce gusts at the surface. Previous research compared the WGE to the Air Force Weather Agency’s non-convective wind gust algorithm. In this research, the WGE is statistically compared to the Rapid Update Cycle’s (RUC) wind gust algorithm that is empirically derived to produce wind gusts forecasts in the RUC model. Utilizing a WRF ensemble data set, the statistical results show the RUC performed better overall at three of the five locations when evaluated with the ≥35 knot threshold. Case study analysis revealed that the WGE performed best on seven of the ten case studies. A best fit linear regression is applied to both algorithms and the performance is evaluated on ten independent case studies to analyze accuracy improvements and the potential use of such tuning to the algorithms for future applications. The results of this research suggest that integration of both non-convective wind gust forecast methods into operational forecasts at the 15th Operational Weather Squadron could prove valuable with further testing and evaluation against established rules of thumb and other accepted techniques.

**KEYWORDS:** Non-convective Wind Forecasting Methods, Wind gusts, Forecasting, Meteorology, Wind Gust Estimate, Rapid Update Cycle, Boundary Layer, Turbulence, Turbulent Kinetic Energy, Weather
VERIFICATION OF CLOUD ANALYSES USED TO SUPPORT OVERHEAD IMAGERY COLLECTION
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Second Reader: Karl D. Pfeiffer, Department of Information Sciences

We verified the USAF Worldwide Merged Cloud Analysis (WWMCA) against observations from the Cloudsat atmospheric sounder and analyzed WWMCA data for 2010 for two regions that are of high interest to the national intelligence community and that differ in their meteorological characteristics. The two regions covered were: (a) much of southwest Asia; and (b) much of western Russia and the Barents Sea. We analyzed WWMCA performance according to four criteria: (1) type of cloud event (definite-cloud, probable-cloud, and no-cloud); (2) geographic region; (3) time of day; and (4) time of year. We measured WWMCA performance using contingency table metrics and found marked differences in performance for the four criteria. In particular, WWMCA tended to perform better in analyzing: (a) no-cloud and definite-cloud events than probable-cloud events; (b) the lower latitude region than the higher latitude region; and (c) persistent cloud events than variable cloud events. Our Heidke skill scores indicated that WWMCA performance was, in general, moderately better than that of a random set of analyses. Overall, WWMCA performance was problematic, given that WWMCA is a near real-time analysis product and is designed to initiate short-lead-time cloud forecasts used by the intelligence community.


A CLIMATOLOGICAL STUDY OF HURRICANE FORCE, EXTRATROPICAL CYCLONES
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Second Reader: Wendell A. Nuss, Department of Meteorology

Using data compiled by the National Weather Service Ocean Prediction Center, a hurricane force extratropical cyclone climatology is created for three cold seasons. Using the criteria of Sanders and Gyakum (1980), it is found that 75% of the 259 storms explosively deepened. The frequency maximum in the Atlantic basin is located to the southeast of Greenland. In the Pacific, two maxima to the east of Japan are identified. These results are in good agreement with previous studies, despite different cyclone subgroups, datasets, and methodologies.

Composite analyses illustrate the hurricane force wind subgroup of extratropical cyclones, similar to other extratropical cyclones, form in regions of anomalously strong baroclinicity and begin to intensify upstream of an upper-level positive PV anomaly. By the end of the 24-hour period of maximum deepening rate, the com-
Composite storm structure appears nearly vertically stacked. Shortly after this time, the storm begins to weaken. There is some indication that diabatic processes serve as an additional energy source.

Brief examination of predictability using ECMWF and NCEP ensemble data to analyze two randomly-selected storms indicate significant features like storm track and intensity are not properly captured by the ensemble prediction systems.

**KEYWORDS:** Extratropical Cyclones, Hurricane, Vorticity, Climatology, Explosive Deepening, Composite, Anomaly, Ensemble.

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**EVALUATION OF SEA-ICE KINEMATICS AND THEIR IMPACT ON ICE-THICKNESS DISTRIBUTION IN THE ARCTIC**

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Sea-ice area and thickness have been on the decline in the Arctic over the past several decades. Understanding the role of ice motion, deformation, and export is important to determining if the Arctic will continue toward seasonal ice coverage or if natural variability is capable of reversing this trend. We have analyzed sea-ice model output and satellite data to advance the understanding of potentially critical physical processes and feedbacks in the region. In particular, comparisons of RGPS data and sea ice results from ice-ocean and fully coupled regional climate models have been made to evaluate model skill in representing ice kinematics. Both sea-ice model configurations maintain a 1/12º (~9km) horizontal spacing and multiple thickness categories in each grid cell. Advanced model representation of sea ice deformations, combined with high spatial resolution, allow direct comparison with satellite data for resolving small-scale linear kinematic features, which contribute to changes in sea ice thickness distribution. These results offer an improved insight into what forces determine the survivability of sea ice in the Arctic.

**KEYWORDS:** Arctic Ocean, Arctic Sea Ice, Sea Ice Variability, Coupled Ice-Ocean Model, Sea Ice Dynamics, Sea Ice Thickness Distribution

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**CLIMATOLOGICAL FACTORS AFFECTING ELECTROMAGNETIC SURFACE DUCTING IN THE AEGEAN SEA REGION**

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Co-Advisor: Tom Murphree, Department of Meteorology

We studied the conditions that affect atmospheric electromagnetic surface ducts in the Aegean Sea region and how those conditions are related to regional and global-scale climate variations. As a primary source for our calculations, we used radiosonde soundings from three different stations situated around the Aegean Sea, analyzing a 20-year period, from 1991 to 2010. We derived statistics on ducting parameters and correlated them with the seasonal means of selected climate system variables. We focused on seasonal and interannual variations in surface ducting frequency, height, and strength gradient.

We found that variations in low-level atmospheric moisture were a dominant factor governing variations in surface ducting conditions. The moisture variations were mainly associated with fluctuations in: (1) moisture advection associated with mid-latitude cyclones in winter; and (2) local and regional evaporation in sum-
The frequency of surface ducts in the summer was twice that for the winter due to larger amounts of atmospheric moisture in the summer. Variations in large-scale subsidence did not seem to significantly affect surface ducting variations. From an interannual perspective, the years that were characterized by increased moisture amounts also tended to exhibit stronger and more frequent ducting conditions for both winter and summer. We found significant correlations between Aegean surface ducting conditions and: (1) local and regional moisture \((r = 0.85\) with significance level \(p = 99\%\); and (2) climate variations that affect local and regional moisture, such as those associated with the Arctic Oscillation (AO), North Atlantic Oscillation (NAO), and south Asian monsoon conditions \((r > 0.60\) with \(p > 95\%\)). As a by-product, we also discovered significant correlations \((ranging from r = 0.67 to r = 0.96 with p > 95\%\)) between ducting parameters and the vertical resolution of the radiosonde data, indicating that differences in data collection procedures need to be accounted for when conducting ducting analyses based on radiosonde data.

**KEYWORDS:** Surface ducts, Ducting Conditions, Modified Refractivity, Aegean, Mediterranean, Frequency, Height, Strength Gradient, Arctic Oscillation, North Atlantic Oscillation, Azores High, Indian Thermal Low, Etesian Winds, Mixing Ratio, Interannual Variability, Radiosonde Soundings, Resolution

**HIGH-IMPACT WEATHER ASSOCIATED WITH A PREDECESSOR RAIN EVENT OVER MISAWA AIR BASE**

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Two significant rain events of greater than 100 mm 24 h\(^{-1}\) occurred over Japan in direct association with tropical moisture transport from Typhoon (TY) Roke in September 2011. The first event occurred over Misawa Air Base, Japan during 17–19 September 2011. Based on analysis of satellite imagery and numerical simulations, the Misawa rain event is classified as a predecessor rain event (PRE). A PRE is defined as a region of heavy rainfall that occurs thousands of kilometers poleward of a tropical cyclone (TC). The second rain event occurred over Nagasaki on 18 September 2011 and does not meet the requirements for PRE classification. The Department of Defense (DoD) TC warning process focuses on TC induced sustained high winds and their proximity to landfall. This analysis shows the link between the Misawa PRE and Roke via the poleward transport of deep tropical moisture. Because excessive rainfall is considered a destructive force associated with TCs, it is the purpose of this thesis that the U.S. Navy’s tropical cyclone conditions of readiness \((TCCOR)\) procedures reflect PRE conditions in order to raise awareness within all meteorology communities amongst the DoD in efforts to minimize risks to DoD installations and personnel.

**KEYWORDS:** Tropical Cyclone, Typhoon, Warning, TCCOR, Predecessor Rain Event, PRE, Roke, Precipitable Water, PW, Misawa, Japan, OPNAVINST

**ENTRAINMENT ZONE CHARACTERISTICS AND ENTRAINMENT RATES IN CLOUD-TOPPED BOUNDARY LAYERS FROM DYCOMS-II**

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The major objective of this thesis is to understand entrainment zone properties and the cloud-top entrain-
ment rates using in situ aircraft measurements. The entrainment zone is defined objectively using a new method based on turbulence perturbations from high-rate turbulence samplings taken during the Dynamics and Chemistry of Marine Stratocumulus (DYCOMS-II) field study. The entrainment interfacial layer (EIL) of the stratocumulus-topped boundary layer (STBL) is defined as the region near the cloud top where mixing occurs between dry free-troposphere air and moist turbulent air. Although the concept of the entrainment zone is clear, defining the top and bottom altitudes of the EIL from vertical profiles of tracer variables is complicated by many factors including an insufficient number of sounding profiles to provide good statistics. This issue is further complicated by the presence of multiple interfaces near the cloud top often used as a substitute for the EIL. As a result, the region that comprises the entrainment zone is not clearly defined. This study examines the characteristics of several important interfaces such as the cloud top, the inversion layer, the interface between turbulent and non-turbulent layers, and the EIL. The relative heights and depths of these interfaces are studied using a large number of sounding profiles from five DYCOMS-II flights. The characteristics of the EIL jump conditions were also analyzed; their variability illustrates the complexity of the jumps and therefore the uncertainty in entrainment rate calculations. Entrainment rates were estimated from jump conditions obtained in this thesis and compared to previous studies.

**KEYWORDS:** Cloud-top entrainment, Entrainment-zone structure, Aircraft measurements, DYCOMS, DYCOMS-II, Entrainment zone, Boundary layer, Stratocumulus-topped boundary layer, Turbulence, Mixing

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**UPPER-OCEAN CHARACTERISTICS IN THE TROPICAL INDIAN OCEAN FROM AXBT AND AXCTD MEASUREMENTS**

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This study focuses on understanding the coupling processes that take place in air-sea interaction during the active and suppressed phases of Madden-Julian oscillation, and specifically the initiation of MJO. Data used for this study was gathered by a NOAA WP-3D research aircraft under the framework of the Dynamics of the Madden-Julian Oscillation (DYNAMO) research project. The aircraft-based measurements extended from 01 November to 13 December 2011, when twelve research flights were flown in total. A total of 316 AXBT and 114 AXCTD ocean profilers were deployed, yielding 289 AXBT and 106 AXCTD usable profiles that were used for this thesis. For the first time, in situ measurements were made in this region of the world where MJO is initiated. This thesis documents the data quality control and quality assurance efforts for all measured profiles, especially for the AXCTD profiles. It also provides a first look into the large scale variability in the DYNAMO domain and vicinities, and the time variability of the tropical Indian Ocean during the WP-3D operation period. The measurements of the upper ocean reveal enhanced mixing in the active MJO phase and the presence of a warm, stratified, and variable upper ocean in the suppressed phase of MJO. The AXBT/AXCTD measurements also suggest increased mesoscale variability under active convection. Its feedback with the evolution of tropical convection should be investigated in future research.

**KEYWORDS:** Ocean mixed layer, Air-sea interaction, Coupling processes, Madden-Julian Oscillation (MJO), Dynamics of the Madden-Julian Oscillation (DYNAMO), AXBT, AXCTD
Wave reflection of sea-swell (0.05–0.20 Hz) energy on a two-slope (1/7.6 nearshore and 1/19 offshore) steep beach with no subaqueous sandbar is studied. The dataset were collected using a cross-shore array of 4 Acoustic Doppler Current Profilers measuring velocity and pressure at 1 Hz continuously for 40 days. Measurement of pressure and velocity at the same location allows data to be decomposed into onshore and offshore components to determine reflection. The long data set captured a wide range of wave conditions at various tidal stages. Observations show low amplitude long period waves produced energy reflection coefficients up to 80%, with most in the 30–50% range. There was a measured increase in the number of nodes and anti-nodes at higher frequencies and observations farther offshore consistent with theory. Field data were compared to an analytical two-slope model that predicts the cross-shore nodal structure of standing waves. The predicted locations of nodes and anti-nodes are in good agreement with observations.

KEYWORDS: Wave Reflection
The use of simulation to train watchstanders in marksmanship would provide a valuable and flexible training asset to the Navy, resulting in minimal lost training opportunities due to operational commitments at sea. We hypothesized that (1) simulation-based marksmanship training would transfer to live fire better than dry fire training, and (2) the experimental (simulation) group would have a better chance of retaining their marksmanship skills than the control group after two or four weeks with no instruction.

Thirty-four active duty military volunteers were randomly assigned to receive either simulation training using the Indoor Simulated Marksmanship Trainer (ISMT) or standard naval marksmanship training and given either a two- or four-week gap between training and final live fire events. Main measures of marksmanship performance were mean point of impact (MPI) of group shots and scores on the standard Navy Handgun Qualification Course.

Results partially supported the hypotheses. The simulation group showed greater improvement in MPI than the control group from baseline to live fire. However, no significant differences were found between the two- and four-week gaps in either case tested, suggesting a longer time gap is needed to test skill retention. Results suggest that simulation training is as effective as standard navy marksmanship training and would benefit the Navy to incorporate ISMT as an at-sea marksmanship trainer.

KEYWORDS: Simulation, Training Transfer, ISMT, M9, 9mm, Live Fire, MPI, Group Shot Diameter

EXPERTISE ON COGNITIVE WORKLOADS AND PERFORMANCE DURING NAVIGATION AND TARGET DETECTION
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Today’s military pilots are required to perform multiple tasks simultaneously, including maintaining control of the aircraft, navigating, communicating, and detecting targets. Mental workload may affect a pilot’s ability
to effectively learn to manage these tasks. Studies have shown that there are certain involuntary, physiological changes in eye gaze patterns, such as blink rate, frequency of fixations, and saccade rate that indicate increased mental workload. We hypothesize that experienced pilots, defined by total flight hours, would show more efficient eye scan patterns (higher frequency of fixations, lower dwell durations, and higher frequency of saccades per minute) during simulated tasks that required navigation and target detection and identification (tD&I). This would therefore lead to better performance in tD&I tasks.

Fourteen active duty military pilots completed three different scenarios while operating the flight controls in a helicopter flight simulator: overland navigation, tD&I while on autopilot, and tD&I while completing overland navigation. Eyetracking data were collected while the pilots completed the scenarios. Flight experience did not correlate to scan pattern or task performance. It did, however, show an interaction with cognitive workload as judged by blink rate. Results indicate that implementing eyetracking information into current aviation training programs could improve training effectiveness and efficiency.

**KEYWORDS:** Navigation, target detection, identification, expertise, pilot, flight, experience

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**THE SEA OF SIMULATION: IMPROVING NAVAL-SHIPHANDLING TRAINING AND READINESS THROUGH GAME-BASED LEARNING**

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Currently, a gap exists between seminar-style shiphandling training and higher fidelity simulations available to the U.S. Navy Surface Warfare Officer (SWO). There is currently no individually accessible, low cost, intermediate level, interactive modality shiphandling resource that would allow SWOS to practice shiphandling skills without requiring instructor oversight. A student research team from the Naval Postgraduate School’s MOVES Institute exposed newly commissioned SWO students at the Surface Warfare Officers School to basic task scenarios designed to be complementary to material covered in their introductory course of instruction utilizing VSTEP’s “Ship Simulator Extremes” game. The students completed the treatment task trainer protocol utilizing a Coast Guard High Endurance Cutter model and continued with the standard introductory course curriculum where they utilized the fully immersive Conning Officer Virtual Environment (COVE) shiphandling trainer. Students were later evaluated in COVE on their ability to maneuver a Guided Missile Destroyer, a similarly configured but larger ship, underway from a San Diego pier. The students exposed to the game-based scenarios performed at a statistically significantly higher level in the categories of “Standard Commands” and “Margins of Safety Maintained”—two key indicators of shiphandling proficiency—following their normal course of instruction, than the control group. Also of note, the novice level students encountered difficulty in unlearning the handling characteristics of one model and learning a new one through the course of their instruction. Our findings suggest that an individually accessible, game based, shiphandling task trainer with ship models matching those found in the COVE and Full Mission Bridge would benefit newly commissioned SWOs by reinforcing classroom instruction. This trainer could potentially be used by SWOs of all skill levels as a self-study tool prior to participation in high level, fully immersive, and manpower intensive, naval shiphandling simulators.

**KEYWORDS:** Game Based Learning, Shiphandling Training, Shiphandling Simulation
This thesis provides a framework to model human belief and misperception in helicopter overland navigation. Helicopter overland navigation is a challenging mission area because it is a complex cognitive task, and failing to recognize when the aircraft is off-course can lead to operational failures and mishaps. A human-in-the-loop experiment to investigate pilot misperception during simulated overland navigation by analyzing actual navigation trajectory, pilots’ perceived location, and corresponding confidence levels was designed. Fifteen military officers with prior overland navigation experience completed four simulated low-level navigation routes, two of which entailed autonavigation. Analysis shows that there is not a negative correlation between perceived and actual location of the aircraft, inferring that confidence is not a good indicator of performance. There is, however, some evidence that there is a negative correlation between perceived location and intended route of flight, suggesting that there is a bias towards that intended flight route. If aviation personnel can proactively identify the circumstances in which usual misperception occur in navigation, they may reduce mission failure and mishap rate. Fleet squadrons and instructional commands can benefit from this study to improve operations that require low-level flight while also improving crew resource management.

**KEYWORDS:** Training, Simulation, Human Factors, Aviation, Helicopter, Navigation, Confidence, Overconfidence, Perception, Misperception, Bayes
DETERMINING OPTIMAL EVACUATION DECISION POLICIES FOR DISASTERS

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Decision making in the face of uncertainty is a difficult task, and this is exacerbated when the decision is irreversible, it involves a near-term deadline, and/or the cost of a bad decision is high. Deciding whether to stay or evacuate from an impending natural disaster is difficult for all of these reasons. This thesis explores the evacuation decision as a Markov decision problem. We develop a generic disaster model to explore the tensions and tradeoffs in the decision to evacuate and use a dynamic programming algorithm to determine optimal decision policies for the decision maker. We explore how these policies are affected by evacuation costs as well as disaster uncertainty.

KEYWORDS: Disaster, Evacuation, Decision Theory, Dynamic Programming, Decision Policies

ANALYSIS OF SELF-PROPELLED SEMI-SUBMERSIBLE ROUTES IN THE EASTERN PACIFIC OCEAN (U)

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(U) The increased violence over the last five years in Mexico and Central America is primarily the result of illegal narcotics smuggling through the Eastern Pacific Ocean and Western Caribbean Sea. In the Eastern Pacific Ocean, drug cartels use what is known as a Self-Propelled Semi-Submersible (SPSS) to transport narcotics from Colombia into Mexico and Central America. These craft are specifically designed to avoid detection while in the water and carry larger amounts of cocaine per vessel than any other type of narcotics conveyance method known today. Coupled with the use of advanced counter-detection methods and sophisticated transportation networks, these craft have become a primary focus of law enforcement agencies throughout the region. This research focuses on the transportation networks used by the SPSS vessels, and provides analysis of the routes from origin to destination locations as well as the amount of cocaine transported into Mexico and Central American countries. Additionally, this information is converted into file types that can be viewed in commercial geobrowsers as well as displayed graphically in order to fully understand these relationships. Further analysis focuses on route distances as well as SPSS interdiction rates. Through in-depth analysis, this research takes a crucial first step in providing law enforcement agencies the additional tools to further enhance counter-narcotics operations in the Eastern Pacific Ocean.

KEYWORDS: Self-Propelled Semi-Submersible (SPSS), Counter-Narcotics and Terrorism, Cocaine Interdiction, Self-Propelled Semi-Submersible Routes, Drug Smuggling Routes
OPTIMIZING MARINE CORPS MAINTENANCE PERSONNEL
CONVERSION TO THE JOINT STRIKE FIGHTER
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The United States Marine Corps (USMC) is replacing its fixed wing fighter and attack aircraft with the new F-35B Joint Strike Fighter (JSF). The Marines’ F-35B will replace three aging aircraft: F/A-18 A+/C/D Hornet, AV-8B Harrier, and EA-6B Prowler. With the retirement of these aircraft, their associated military occupational specialties will become obsolete. The F-35B is an expensive asset and once it is delivered the USMC wants it to be immediately operational. One of the challenges is how to prescribe the right types of maintenance personnel for accession and conversion to the JSF community as it gets established, while maintaining adequate quantities of experienced personnel in the legacy communities. This thesis develops an Integer Linear Program (ILP) that prescribes the number of maintenance personnel for monthly transition and accession into the new JSF community. The ILP reveals possible shortage or overfill of manning for each new squadron taking into consideration the rank and years of service of available personnel for each month of an 11-year planning horizon. Using realistic data, we demonstrate the use of the ILP under different levels of accession and allowed transition for four different types of maintenance personnel.

KEYWORDS: Integer Linear Program, Optimization, Manpower Model, F-35, Joint Strike Fighter, United States Marine Corps, Maintenance Personnel Transition

MEASURING COMBAT LOGISTICS FORCE (CLF) ADEQUACY IN SUPPORTING NAVAL OPERATIONS
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We use the existing outputs of the Combat Logistics Force (CLF) Planner tool to: (1) assess the minimum level of support required for a specified force in a multi-stage naval combat scenario and (2) compare CLF adequacy, surplus mission capability, and logistics shortfalls that a minimum level of support provides to combat forces of varying compositions. We examine the potential impact of the transition from a traditional nuclear-powered aircraft carrier strike group to a more distributed conventionally-powered one. We find that the logistical demands of a small conventionally-powered carrier strike group with comparable striking power require significant increases in CLF end strength, and therefore that logistical supportability must be an integral part of future fleet planning.

KEYWORDS: CLF, Logistics, CLF Planner, New Navy Fighting Machine, NNFM
In recent years, “optimal” manning has been implemented on U.S. Navy surface ships where crew sizes have been reduced. This undermanning has resulted in a requirement for sailors to stand longer watches and get less sleep, making for less effective sailors on watch. Alternative watch schedules can be used that minimize the fatigue of sailors on watch. The first objective of this study is to analyze a USS San Jacinto crew survey, which compared an alternative watch schedule to more traditional watch schedules. The second objective is to create and analyze various notional use cases of watch schedules to maximize predicted performance while on watch. Crew fatigue is analyzed using the Fatigue Avoidance Scheduling Tool (FAST) program for various cases of notional watch. It was found from the USS San Jacinto survey results that enlisted and officers both preferred the alternative 3/9 watch schedule when compared to other watches that the crew members stood in the past. When comparing the predicted effectiveness while on watch, it was found that the 3/9 watch was best for four section duty, the straight fours was best for three section duty, and the 12/12 watch was best for two section duty.

KEYWORDS: Watch standing, shipboard manning, scheduling sailors, hours of service, maritime operations, fatigue avoidance.

The U.S. Marine Corps developed the Combat Active Replacement Factor (CARF) methodology as a way to obtain reliable logistics planning factors to aid in the estimation of equipment losses in future conflicts. The continuous evaluation and validation of these types of methodologies is considered of critical importance, since its effects directly impact combat effectiveness, supply chain management, logistics, acquisitions, and overall budgeting. This thesis analyzes a proposed methodology for use in calculating explicitly calculated CARFs (ECCs) making use of real-world master data repository (MDR) data from previous low- and medium-intensity conflicts. As well, this thesis analyzes proposed regression models used in calculating federal supply code (FSC) and federal supply group (FSG) CARFs. We employ bootstrapping techniques in order to analyze the sensitivity of ECCs and find that as many of 70% may exhibit extreme sensitivity to reasonable changes in usage data. We employ ordinary least squares regression models to estimate CARFs by FSC and FSG and obtain dramatically more CARFs relative to the draft methodology. Finally, a cross validation of a sample of the regression models reveals that CARFs generated from such models tend to vary substantially from their actual values.

KEYWORDS: Combat Active Replacement Factor (CARF), Explicitly Calculated CARFs (ECCs), Federal Supply Code Regressed CARF (CRC), Federal Supply Group Regressed CARF (GRC), Ordinary Least Squares (OLS), Bootstrapping.
Decrease in Arctic Ocean perennial sea-ice has been observed in recent decades. As sea-ice continues to decline, marine traffic will increase and the United States will require a more active military presence in the Arctic. Future Arctic conditions must be forecasted with increased accuracy to allow for proper planning with regard to the nation’s changing role in the region. It is the goal of this thesis to contribute to the knowledge of turbulence and mixing associated with ice keels in the Arctic Ocean in order to improve the accuracy of predictive coupled ocean/ice/atmospheric models.

At Applied Physics Laboratory Ice Station 2011, a 3-dimensional (3-D) sonar was used to record high resolution morphological measurements of an ice keel approximately 33 m long by 29 m across and 10 m deep. Sensors were deployed in the water column approximately 10 m from the keel to record water properties of salinity, temperature, and 3-D velocity at selected depths in the upper water column. These observations were used to make calculations of turbulence within the mixed layer, in order to gain a greater understanding of how keels affect turbulent drag and heat fluxes in the upper ocean.

Results indicate that keels generate significant turbulence and mixing in the upper ocean, even during benign weather conditions in which there is little surface forcing. Keels increase the kinetic energy of the upper ocean through production of turbulent eddies during times of weak stratification and the generation of internal waves during times of strong stratification. Keel-induced turbulence and mixing may lead to entrainment of warmer water underlying the surface mixed layer that could be a contributor to ice melting.

Calculation of the quadratic drag coefficient $C_w$ also indicated that $C_w$ varies greatly with water column stratification and ice undersurface roughness. Values as high as 0.08 were seen in the wake of a 10 m ice keel during strong stratification, and as low as 0.002 when the current was not affected by the keel during weak stratification. Most numerical models utilize a constant value of 0.0055 for $|C_w|$. Varying $|C_w|$ based on ice roughness and water column structure could greatly improve model accuracy.

**KEYWORDS:** Arctic Ocean, Beaufort Sea, Ice Concentration, Ice Morphology, Ice Roughness, Sea Ice, Ice Keel, Mixed Layer, Turbulence, Ocean Heat Flux, Mixing Length, Dissipation Rate, Drag Coefficient
The purpose of this joint applied project (JAP) was to determine, through data collection, any life-cycle cost savings of a synchronous training approach versus the more traditional on-site new equipment training (NET) approach. With Army units and equipment deployed throughout the world, the cost of providing on-site training can be prohibitive.

The Army has made effective use of distance learning approaches to meet both career training objectives (e.g. Defense Acquisition University (DAU) and Naval Postgraduate School and workplace training requirements (e.g. ethics and security). Similar approaches to replace on-site training for equipment, especially NET, could result in not only cost savings, but also result in better use of training personnel due to reduced travel time.

The primary concern with this synchronous training approach is the quality and effectiveness of training. By drawing on expertise of both Program Management Offices as well as other life-long learning-based institutions (i.e. DAU, Naval Postgraduate School personnel for expertise in distance learning, the Army acquisition programs could be able to replace a significant portion of on-site training with synchronous training.

**KEYWORDS:** Synchronous Training Approaches, Measures of Effectiveness and Suitability, New Equipment Training (NET), Relative Training Costs, Learning Styles.
Nearshore depths for Waimanalo Beach, Hawaii are extracted from optical imagery, taken by the World-View-2 satellite on 31 March 2011, by means of automated wave kinematics bathymetry (WKB). Two sets of three sequential images taken at intervals of about 10 seconds are used for the analyses herein. Water depths are calculated using a computer program that registers the images, estimates the currents, and then uses the linear dispersion relationship for surface gravity waves to estimate depth. Depths are generated from close to shore out to about 20 meters depth. Comparisons with SHOALS LIDAR bathymetry values show WKB depths are accurate to about half a meter, with R² values of 90%, and are frequently in the range of 10-20 percent relative error for depths ranging from 2-16 meters.

KEYWORDS: Remote Sensing, Multispectral, Panchromatic, Nearshore, Bathymetry, World View-2, WKB, Wave Kinematics Bathymetry, Depth Inversion, Wave Motion, Dispersion Relation, Currents
LINK PERFORMANCE ANALYSIS OF A SHIP-TO-SHIP LASER COMMUNICATION SYSTEM
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The benefits of high data rates, high directionality, low sidelobes, small size, light weight, and low power of laser communications (lasercom) as compared to radio frequency (RF) communications make laser an attractive option for ship-to-ship communications. The realization of the option requires ship-to-ship lasercom system design and mission planning, which, in turn, necessitates a lasercom link budget analysis and a parametric analysis of lasercom system design and operational parameters. The link budget analysis determines whether the energy of a laser signal is adequately transmitted to a receiver. The parametric analysis determines the lasercom system design and operational parameters that meet ship-to-ship lasercom requirements. Maritime environmental conditions (atmospheric and water surface conditions) that affect lasercom link budget are investigated. The link budget takes into consideration transmitted and received power, gains, propagation losses, and implementation losses. The results of the link budget analysis and the parametric analysis can be used to analyze and trade the design and operational parameters contributing to a link budget that meets communications requirements and to gain understanding of the operational boundaries and limitations of lasercom.

KEYWORDS: Lasercom, Link Budget, Atmospheric Attenuation, Acquisition, Tracking and Pointing.

DEVELOPING EVALUATION MEASURES FOR THE SECOND STAGE NEXT GENERATION ENGINE ON EVOLVED EXPENDABLE LAUNCH VEHICLES
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The United States has been the leading nation in space technology, as space is a vital asset in military dominance. But to sustain its position in the area of space lift, the current U.S. second stage liquid propulsion engine, the RL10 (developed in 1958) needs to be replaced. This replacement requires systems engineering methods and new technological advances to adhere to mission requirements and constraints of current platforms. This thesis provides a history of the Evolved Expendable Launch Vehicle (EELV), U.S. liquid propulsion, and the RL10 LH2/LOx engine to analyze tradeoffs between major requirements in new upper stage development and to provide a recommendation of evaluation measures. The results are a proactive case presenting the benefits of a new upper stage engine on EELV, a tradeoff comparison between rocket propulsion engine cycles, a waterfall model for engine qualification and testing of liquid propulsion rocket engines, and testing recommendations for NGE qualification. Additionally, the thesis recommends specific impulse,
thrust, and thrust-to-weight values that should be used as a design baseline for the next generation upper stage engine on EELV. These recommendations should be of value to engineers or program managers who are or will be responsible for acquiring replacement propulsion systems.

**KEYWORDS:** upper stage, liquid propulsion, second stage, evolved expendable launch vehicle, EELV, expander cycle, regression analysis, next generation engine, rocket engine, LPRE, rocket testing, propulsion

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**EMBARKABLES ROOT CAUSE FOR NAVY NETWORKS**

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Network-centric warfare (NCW) is the Navy’s central concept for organizing its efforts to transform itself for military operations in the 21st Century. This concept links together Navy ships and shore sites into highly integrated networks to provide geographically dispersed war fighters and decision makers real-time information exchange at every level.

As the Navy continues its efforts to align network operations, the existing IT structure is falling short in meeting war fighter requirements. Interoperability among DON networks is critical to improving combat capability and efficiency. Navy war fighters require seamless access to IT services while deployed anywhere in the world. The embarkables process provides the ability for users to move their workstation between networks but consists of a complex and time-consuming IT process when transitioning from shore facilities and to ship environments. This thesis identifies root causes for network interoperability problems faced by embarking units when connecting to alternate networks, in this case the information technology for the 21st Century environment. It also recommends approaches to improve integration of ashore assets into the shipboard environment, and suggests further areas of research for a seamless user experience moving across networks.

**KEYWORDS:** NMCI; OCONUS ONE-NET; IT-21, Embarkables; Deployables; Network Interoperability.

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**APPLICATION OF AN ENTROPIC APPROACH TO ASSESSING SYSTEMS INTEGRATION**

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Systems integration is a major endeavor in the development of a system. The goal of integration is to bring separately developed components to create the required system within both the defined schedule and the allocated budget. An entropic approach to assessing the success in attaining the goal, i.e., systems integration success, involves representing the system as a network, whose nodes are the elements of the system and whose links are the connections among the elements, and determining and tracking system network entropy. The work in this thesis considers more than two possible states for each link, explicitly assigning probabilistic measures to systems development and integration activities, and applying it to the integration of a robot used in the detection and destruction of improvised explosive devices. This work demonstrates the feasibility of applying this entropic approach to assessing systems integration success and, specifically, the feasibility of using network entropy as a metric to aid in systems integration.

**KEYWORDS:** Network entropy, systems integration assessment, Markov chain, Monte Carlo simulations
Squadron Officer College (SOC) provides professional military education to captains in the U.S. Air Force. Improved requirements elicitation, work-breakdown structure analysis, and capacity analysis are recommended to improve the effectiveness and efficiency of SOC. Because course length is constrained by other USAF needs, a method for trading requirement satisfaction using stakeholders is recommended to maximize value from the available time. Significant efficiencies are identified that can result in increased student throughput, increased curriculum content, or both.

Currently, SOC can graduate 4,060 students yearly and has facilities to handle over 6000 students per year. Increasing the percentage of staff that actively teaches has the greatest effect on throughput; 36% of staff are actively instructing. Administration and organization efficiencies should be explored to increase the percentage of active instructors.

Implementing a continuous improvement cycle could increase student learning regardless of throughput. Spiral development could be implemented to update lessons or the entire course. Customer feedback and stakeholder involvement need to be improved; currently, SOC customers, Air Force commanders, do not have a direct and timely way to influence curriculum design.

Using different delivery modalities, SOC may find new efficiencies or increase learning effectiveness. SOC should examine combinations of online delivery methods in order to reduce course length or costs.

KEYWORDS: Squadron Officer College, Squadron Officer School, Spaatz Center for Officer Education, Air University, Air Education and Training Command, Professional Military Education, Basic Developmental Education

For more than a half century, the United States government has been acquiring and launching satellites. However, throughout these years there has been a shift in the space-systems acquisitions model, from acquiring greater quantities of less complex satellites, to fewer quantities of drastically more complex, individualized satellites. Within the past two decades when a new satellite was to be built, whether as part of an existing generation of satellites or the first of its kind, it appears that the acquisition process starts over from the beginning.
as if it was the first time building a satellite. This shift in the model has resulted in these individualized systems being extremely costly and takes a long time to be produced. The acquisition of DoD’s weather satellites is one such example.

This thesis researched the history of some Air Force space acquisitions programs, current factors affecting the way systems are acquired, and new processes, Fast, Inexpensive, Simple, Tiny (FIST), and Evolutionary Acquisition for Space Efficiency (EASE), that are intended to remedy the aforementioned problems. In addition, Toyota’s process for producing new vehicles models was also reviewed. These three approaches were then applied to the DoD’s weather satellite program to develop recommendations for its follow-on program’s acquisition strategy.

**KEYWORDS:** Systems Engineering, Space Systems Acquisition, Satellites, Process Improvement, Defense Weather Satellites
MASTER OF ARTS

Security Studies
The Arabian Gulf is a strategically significant region of the world with regard to the global energy supply chain as well as maritime trade and commerce. For the past three decades, the region and Strait of Hormuz, in particular, have witnessed major crisis, wars, and foreign intervention which lead to undermine the stability, peace, and security of the region. Since the collapse of Saddam Hussein’s regime, Iran found propitious opportunity to pursue a regional hegemony. In the name of its national security, nuclear ambitions, and protection of its self-interests, Iran has repeatedly threatened international passage, disrupted maritime shipping and interrupted oil flow through the Strait of Hormuz. On the other side, the Gulf Cooperation Council (GCC) has pursued a collective security approach to achieve balanced outcomes ensuring free oil flow, supporting stability, and maintaining security in this region. Despite these efforts, the situation remains tumultuous, confrontational and uncertain; therefore, the GCC must consider strategic alternatives to establish regional balance of power, achieve a sustainable stability, and ensure security in the Arabian Gulf region.

**KEYWORDS:** Gulf Cooperation Council (GCC), Strait of Hormuz, Arabian Gulf, United Nations Convention on the Law Of the Sea (UNCLOS), global trade, maritime shipping, OPEC, Petrodollar, Oil revenue, sea lines of communication (SLOC), global interdependency, Disruption, territorial sea, innocent passage, transit passage, Iranian Revolution, Hegemony, Non-Proliferation Treaty (NPT), International Atomic Energy Agency (IAEA), nuclear weapons, fragile stability, Khaleejism “Al-Khaljanah in Arabic”, collective security, Joint Defense Agreement, Peninsula Force Shield, Maritime security, alliance.

**FORCE PROTECTION FOR FIREFIGHTERS: WARM ZONE OPERATIONS AT PARAMILITARY-STYLE, ACTIVE-SHOOTER INCIDENTS IN A MULTI-HAZARD ENVIRONMENT AS A FIRE SERVICE CORE COMPETENCY**

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Paramilitary-style, active-shooter attacks in a multi-hazard environment are an emerging threat against the U.S. homeland. Lessons learned from previous paramilitary style attacks demonstrate the breaking points of the fire service policy of “standing by” until law enforcement declares that the scene is secure. When followed, the “standby” policy prevents firefighters from taking calculated risks to accomplish the fire-service mission of saving lives and protecting property. It is likely that the “standby” policy will be ignored when immediate action is required to save lives or mitigate hazards in areas of the incident in which the potential for violence,
but no active threat exists.

The optimal fire-service response policy to save lives and mitigate hazards during paramilitary style attacks in a multi-hazard environment is a “force protection” model in which law enforcement officers accompany and protect fire fighters in the warm zone. This model is an adaptation of the successful “escort” model used by law enforcement and fire fighters during civil unrest incidents. As has occurred many times in the past, the fire service must incorporate a new core mission competency—warm zone operations at paramilitary style attacks.


CREATION OF A HOMELAND SECURITY JAIL INFORMATION MODEL
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September 11, 2001, is a date that resonates in each American; not only lives, but policies and security practices changed that day. The intelligence community expanded its scope to include first responders, private citizens, and private companies. However, the U.S. jail system remains almost entirely overlooked by the homeland-security intelligence community. The jail system provides a unique opportunity to gather real-time actionable intelligence without the need of a warrant. Some of the most villainous and notorious terrorists have spent time in jail and might have been caught or thwarted by a well-trained jail-information team intimately connected to the national intelligence community. The intelligence community has yet to take advantage of the wealth of homeland security information concentrated, and accessible, in the U.S. jail system.

Using qualitative research methods and Yin’s case study analysis, the Intelligence Cycle, and Lowenthal’s IC Functional Flow model in its analytical approach, this thesis explores three homeland security intelligence-gathering models to determine how best practices can be used to create a homeland security jail intelligence best practice model. The U.S. intelligence community will benefit from, and must act upon, the insights that emerged from this research.

KEYWORDS: Intelligence, Jail, Prison, Intelligence Cycle, Terrorism Liaison Officer, Joint Terrorism Task Force, Jail Intelligence

STONE SOUP: A RECIPE FOR BUILDING RESILIENCY AMONG CHILDREN
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Despite a decade of effort, we have seen limited success in increasing the personal preparedness of adults that is thought to create individual and community resiliency. Since inadequate preparation by adults can negatively impact children, preparedness education for children is now a priority. Unfortunately, the current resource-based model of preparedness presents a barrier to many children who have or control limited resources. This highlights the need to examine other approaches to achieving resiliency among children.
This thesis argues that adaptive capacity may be more beneficial for increasing resilience among children, that adaptive capacity can be taught, and that schools are the best place for such education to occur. Lastly, it addresses the significant challenges related to responsibility for teaching and content

**KEYWORDS:** Adaptive Capacity, AmeriCorps, Children, Citizen Engagement, Education, Families, Preparedness, Resiliency, Resource Robustness, Schools, Teachers, Whole Community

**RISK-BASED AVIATION SECURITY: DIFFUSION AND ACCEPTANCE**

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The Transportation Security Administration (TSA) is continually under public pressure to improve aviation security screening for air passengers while simultaneously protecting the public from all perceived threats to commercial aviation.

Applying acceptance models to predict passengers’ intentions to use voluntary security programs could lead to more efficient deployment of technology and procedures or the termination of a security program before significant government resources are dedicated to the program. Accelerated adoption rates of voluntary programs could save the taxpayers millions of dollars and ensure higher levels of security for aviation passengers. Application of acceptance models and diffusion of innovation in government security programs presents a relatively untapped perspective in homeland security and, more specifically, aviation security.

This research provides options for modification of the communication plan for TSA’s risk-based security policy during its initial implementation stages in 2012. Through application of social behavior prediction models such as the theory of planned behavior, technology acceptance models, and diffusion of innovations, TSA could drastically influence the adoption rate of risk-based security policy, potentially increasing the security effectiveness of aviation security while allowing for faster passenger screening necessary to adjust for expected increased flight loads over the next decade.

**KEYWORDS:** Risk-based security, Transportation Security Administration (TSA), theory of planned behavior, technology acceptance model, diffusion of innovations.

**WHISTLEBLOWING IN A WIKILEAKS WORLD: A MODEL FOR RESPONSIBLE DISCLOSURE IN HOMELAND SECURITY**

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Whistleblowing serves as a check/balance system to the government bureaucracy, helping to bypass administrative roadblocks and to provide a mechanism through which homeland security can monitor and increase efficiency in its operations. However, homeland security also deals with information that can be of a sensitive or secret nature, the unauthorized disclosure of which can cause damage to both homeland security efforts and national security. The current process for the authorized submission of whistleblowing information fails to provide whistleblowers the protections they require, instead encouraging whistleblowers to disclose information to the media or through stateless news organizations like Wikileaks to prevent reprisals.

The technological capability to provide whistleblowers protections through anonymity currently exists,
and has been demonstrated to be effective. By leveraging those technologies and setting up an authorized process for responsible disclosure through which homeland-security employees can submit whistleblowing information without fear of reprisals, it may increase the likelihood of whistleblowers reporting issues in the first place, and reduce the number of leaks to unauthorized recipients (media/stateless news organizations).

**KEYWORDS:** Whistleblowing, Wikileaks, Responsible Disclosure, Anonymity, Homeland Security, Over-classification, Information Sharing, Public Trust, Government, Bureaucracy, Transparency, Secrecy, Fraud, Waste, Abuse, Organizational Misconduct, Protection, Retaliation, Reprisal, Technology

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**BEYOND THE WASHINGTON CONSSENSUS: PROMOTING ECONOMIC GROWTH AND MINIMIZING THE THREAT OF VIOLENCE IN LATIN AMERICA THROUGH SOCIAL DEVELOPMENT**

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In this thesis, I examine the role social development plays in the successes and failures of Washington Consensus-type neoliberal economic growth strategies throughout Latin America, as well as the effects of growth on levels of political violence in the region. I also analyze the role of targeted social spending in legitimizing the implementation of structural adjustment programs across all regime types. Finally, I use a discriminate analysis to divide the countries of Latin America and the Caribbean into two distinct geographic and economic subregions where separate development strategies can be optimized.

I perform a Varimax rotated factor analysis on the universe of data and on two subregions to determine those prospective constraints most closely associated with growth potential throughout Latin America. Next, I perform an ordinary least squares regression on 17 Latin American and Caribbean Countries (1970–2000) to determine the influence of targeted social spending on the implementation of structural adjustment programs and another to determine the influence of economic growth and inequality on levels of political violence in Latin America (1996–2008). Finally, I use a discriminate analysis to challenge the World Economic Forum classifications of several Latin American countries, therefore providing better targeted development strategy recommendations in each.

**KEYWORDS:** Washington Consensus, Latin America and the Caribbean, Social Development, Targeted Social Spending, Political Violence, Structural Adjustment Programs, Economic Development, Economic Growth, Inequality

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**PAKISTAN’S FIRST MILITARY COUP: WHY DID THE FIRST PAKISTANI COUP OCCUR AND WHY DOES IT MATTER?**

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The first military coup of Pakistan in 1958 set up a pattern that continues to show itself four decades later and dominate the government either directly or indirectly. The first military coup of Pakistan also created an institutional path for the subsequent three military coups. The first military coup was due to various factors, not
Just one that civil military theorists neglect to explain. The British recruitment policy during the pre-partition period had as large a role in creating the setting for the coup as did unequal distribution of resources and geographical location. Pakistani military at the time of partition was professional while the other institutions were weak, which challenges the notion that professional military do not cause coups. The Pakistani military also gained prominence because of the all-around external and internal threats. The powerful military and bureaucratic alliance further delayed the enactment of a constitution and changed seven prime ministers within first eleven years of independence by further discrediting the politicians before the people. All these events provided occasion, opportunity and disposition to the Pakistan army to affect the first coup by General Ayub Khan in 1958. The thesis also evaluates the effects of the first military coup on the present civil–military relations in Pakistan.

**KEYWORDS:** Pakistan, First, Military Coup 1958, Historical Factors, British Recruitment Policy, General Ayub Khan, Professional Military, Political Roots, Vacuum, Political Leadership, Threats, Military Aid, Political Culture, Occasion, Coup, Military, Analysis, Civil-Military Relations.

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**THE IMPACTS OF SOCIAL MEDIA ON CITIZEN SECURITY BEHAVIOR IN MEXICO**

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Over the past decade, Mexico has seen a dramatic increase in drug-trafficking organization (DTO) violence with the deaths of over 47,000 Mexican citizens that can be compared to high-profile combat zones, such as in Afghanistan. This thesis examines the critical junction between social media and citizen security behavior in Mexico. It begins by assessing the overall social media penetration in Mexico, reviewing the demographic and geographic factors of social media penetration in Mexico, in addition to analyzing what actors influence this technology. Next examined is the use of social media by DTOs. Geographical concentrations of DTO violence, how DTOs utilize social media to their advantage, as well as their use of social media, such as YouTube, are reviewed. Social media use by law-abiding Mexican citizens in their attempts to counter the violence in their communities, specifically focusing on statistics and trends regarding anti-DTO/personal security behaviors is also evaluated. This thesis concludes with not only a review of the findings, but by posing three different scenarios for the next five-to-eight years to which these findings can be applied.

**KEYWORDS:** Social Media, Mexico, Drug-Trafficking Violence, Drug Cartels, Emergence, Complexity

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**IDENTITY-VERIFICATION SYSTEMS AS A CRITICAL INFRASTRUCTURE**

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Identity-management systems are essential to U.S. homeland and economic security. Systemic fragility has been exploited to facilitate terrorist travel and criminal evasion. The widespread dissemination and use of fraudulent identity documents exponentially complicates efforts to target terrorists and other persons who pose a threat to homeland security. Underage drinkers and illegal immigrants are common supporters and users of the fraudulent document industry. No single source can determine the net effect that these entities have in degrading identity system utility.
Identity verification systems are large networks, susceptible to degradation, and vital to other sectors of critical infrastructure. Current attempts to analyze identity systems are segmented and fractured. Analyzing these systems as a comprehensive critical infrastructure provides a necessary framework of language and concepts that are familiar to policymakers. This thesis is focused on providing a thorough understanding of the vulnerabilities associated with weak identity systems and analyzing identity systems as a critical infrastructure.


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**CIVILIAN PROTECTION IN THE EASTERN DEMOCRATIC REPUBLIC OF THE CONGO: EVALUATION OF THE MONUSCO PEACEKEEPING OPERATION**

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Since 2003 language mandating civilian protection (POC) has increasingly appeared in Security Council resolutions, peace support doctrine, and humanitarian frameworks. Despite the frequency of its use, the term lacks a universal definition and a clear gap exists between military operations that attempt to establish, introduce, and/or enforce “civilian protection” and humanitarian approaches to POC concepts. This thesis posits three metrics that should be used to evaluate the effectiveness of peacekeeping operations which aim to establish POC: rates of civilian massacres, rates of internally displaced persons, and incidents of sexual violence. These criteria share both military and humanitarian priorities. They also represent elements of conflict present in the eastern Democratic Republic of the Congo since at least 1998, and each must be reduced in order to establish a minimum standard for civilian protection in the country. The United Nations Organization Stabilization Mission in the Congo (MONUSCO) was charged with implementing POC in the eastern regions of the DRC beginning in 2008. This thesis considers the ability of MONUSCO to address each of the three POC metrics and shows that the mission has fallen short of achieving its mandate to instill minimum standards of civilian protection.

**KEYWORDS:** Civilian Protection, Democratic Republic of the Congo (DRC), Peacekeeping, Stability Operations, Peace Support Operations, Civil-Military Relations, Humanitarian Language, MONUSCO

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**THE SIGNIFICANCE OF FIRE-SERVICE CULTURE AS AN IMPEDIMENT TO EFFECTIVE LEADERSHIP IN THE HOMELAND-SECURITY ENVIRONMENT**

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The tragic loss of 343 firefighters on 9/11 monumentally illustrates that firefighters now stand on the front line in the war against terror. The ramifications of 9/11 forced fire-service leaders to incorporate newly recognized strategies of terrorism management and mitigation into traditional firefighting roles. Blue-collar manual laborers are no longer the archetype of modern firefighters. Instead, firefighters now command with expanded leadership roles within society and the desire to achieve increased levels of local, regional, and national pre-
paredness. This thesis explores the various aspects of fire-service culture that negatively impacts organizational leadership, cultural transformation, and the fire service’s current mission within the homeland-security domain.

This thesis starts by providing a detailed description of the elements epitomized by fire-service culture. It then examines how both internal and external sociological factors contribute to the perpetuation of fire-service culture. Finally, this thesis provides an implementation strategy leaders might utilize when attempting to administer organizational change processes. This author concludes that while leaders might provide a guiding organizational vision, they are but one factor influencing organizational culture. Changes occur when both formal and informal leaders agree upon reasonable organizational goals and orchestrate small cultural shifts when attempting to achieve those goals.

**KEYWORDS:** Culture, leadership, tradition, fire service, social identity, organizational culture, firefighter, organizational change, Seattle Fire Department

**HOMELAND SECURITY: DEVELOPING NATIONAL DOCTRINE TO GUIDE STATE STRATEGY DEVELOPMENT**
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If one subscribes to the belief that doctrine is a common understanding of what fundamental principles guide an organization, then this thesis demonstrates that there is currently no common understanding of homeland security. There is currently a lack of institutional doctrine that can be applied nationally for state level government to develop their homeland security strategies. The military has a long history of successfully using doctrine to develop war-fighting strategy. Comparisons can be made to the Air Force’s use of doctrine to gain autonomy as well as the effect joint doctrine has on achieving unity of effort across disciplines. Additional lessons can be learned from past civil defense attempts at institutionalization and the evolution to emergency management and homeland security. By modeling of these existing, known and accepted doctrines or lack thereof, a national homeland security doctrine could emerge.

**KEYWORDS:** Doctrine, state, homeland security, strategy, policy, military, emergency management, U.S. Air Force, Federal Emergency Management Agency, joint doctrine model

**WHAT’S MY LANE? IDENTIFYING THE STATE GOVERNMENT ROLE IN CRITICAL-INFRASTRUCTURE PROTECTION**
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What constitutes an effective Critical Infrastructure and Key Resources (CIKR) protection program for Massachusetts? This study evaluates existing literature regarding CIKR to extrapolate an infrastructure protection role for Massachusetts. By reviewing historical events and government strategies regarding infrastructure protection, chapters I and II will provide scope and context for issues surrounding critical infrastructure. Chapter
III reviews the roles of the Department of Homeland Security and the Department of Defense, possibly the two most influential organizations tasked to support the federal infrastructure protection initiative.

Chapter IV analyzes the private-sector role in infrastructure protection as articulated in federal strategies, academic research, federally directed studies, and professional journals. The National Infrastructure Protection Plan’s framework for managing the risk to CIKR will be used as a guide in Chapter V to evaluate the infrastructure protection strategies of Arizona, Virginia, and Washington.

Finally, Chapter VI recommends that Massachusetts develop a state infrastructure-assurance program versus a critical infrastructure protection program. Concepts such as reframing the critical-infrastructure debate, creating infrastructure public–private partnerships and information sharing processes to build trust among the entities invested in ensuring the delivery of infrastructure services are recommended for inclusion in a state infrastructure assurance strategy and subsequent infrastructure assurance program.

KEYWORDS: Strategic role, critical infrastructure protection, Critical Infrastructure and Key Resources, infrastructure public-private partnerships, infrastructure assurance program, infrastructure assurance strategy, risk management, delivery of infrastructure services, critical infrastructure protection, infrastructure resilience, public resilience


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This thesis focuses on the root causes of conflict in South Asia that have created the environment in the Afghan–Pakistan border areas, which nurtures insurgency. The causes are rooted in the decisions, made by the British Empire in the 19th and 20th centuries, to perpetuate her rule in the Indian subcontinent. A disregard for the history and its impact on the current events has lead to prolonging of U.S. war in Afghanistan. The conclusion is that colonial history of South Asia has shaped current conflicts in Afghanistan, India, and Pakistan. These conflicts have manifested in spawning of terrorism from the region.

Ever since the partition of India in 1947 by the British, India and Pakistan remain locked in an enduring conflict over Kashmir. This conflict is tied to destabilization of South Asia, including competition between India and Pakistan over influence in Afghanistan. Thus, the U.S. focus on elimination of al Qaeda is short sighted, as it ignores the reasons for al Qaeda’s survival in South Asia. Without Pakistan’s support for the Afghan Taliban and associated terrorist organizations, al Qaeda would not have a sanctuary in South Asia.

Without a resolution of the conflict between India and Pakistan, the terrorism problem emanating from South Asia remains a potential threat. Therefore, it is imperative that U.S. policy should expand to include a resolution of the Indian–Pakistani conflict.

KEYWORDS: Pakistan, India, South Asia, Terrorism, British Empire, Kashmir, British India, Partition of India
THE NATION THAT CRIED LONE WOLF: A DATA-DRIVEN ANALYSIS OF INDIVIDUAL TERRORISTS IN THE UNITED STATES SINCE 9/11
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Lone-wolf terrorist attacks have occurred in the United States throughout the country’s history. Attempted attacks from individual terrorists unaffiliated with terrorist groups may be becoming more prevalent. Both the general public and government officials acknowledge the presence and importance of these attacks; however, relatively little literature exists on the subject compared to group terrorism. Much of the information on lone wolves has been established by case study, inference, and known characteristics of group terrorism. The purpose of this study is to analyze the characteristics of lone-wolf terrorism through formal statistical models. The study then synthesizes data with case study and existing literature to formulate a base of knowledge for lone-wolf terrorism.

This study demonstrates that no single dispositional profile of a lone-wolf terrorist exists. The individuals who engage in the tactic of lone-wolf terrorism form a unique ideology that combines personal grievances with common terrorist goals. Still, many lone-wolf cases exhibit certain characteristics. This thesis analyzes these characteristics and their relationship with successful attacks. These data on characteristics, goals, and motivations of lone wolves purport policies to increase engagement between the community and curb lone-wolf terrorism and its effects.

KEYWORDS: Lone Wolf, Terrorist, Terrorism, Statistical Analysis, Data, Lone Offender, Characteristics, Incentives, Motivations, Goals, Policy, Strategy, Individual

THE VEIL OF KEVLAR:
AN ANALYSIS OF FEMALE ENGAGEMENT TEAMS IN AFGHANISTAN
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Recent developments in the population-engagement strategies associated with Operation Enduring Freedom and the international security-assistance force in Afghanistan have led to the emergence of female engagement teams. These teams seek to provide insight and intelligence while engendering American and ISAF efforts in the region, by utilizing female service members to actively engage and interact with the population. This thesis endeavors to answer the question of how the female engagement teams evolved around combat exclusion and whether, given the nature of the conflict in Afghanistan, they can serve to facilitate missions of counterinsurgency and population engagement. This paper will serve as the beginning of the academic analysis of this concept and policy for potential use in future determinations by civilian and military leadership. Understanding of both the tribal networks wielded by women and their capacities to influence their world, while still recognizing the given constraints and realities of gender seclusion, are a necessity to truly exploit the human and cultural terrain in Afghanistan. The FETs despite the restrictions of combat exclusion seem the preeminent means by which to tap into this fountain of possibility.

KEYWORDS: Afghanistan, Female Engagement Teams, Combat Exclusion, Counterinsurgency, Population Engagement
Owning and operating airports is an expensive business. For many local governments and private corporations involved, the business of airport management can be extremely lucrative when the facility and the operation are effectively and efficiently administered. For the DoD, airport management is a huge expense. During this time of historic budget reductions, one wonders whether the existing portfolio of military airfields can be sustained. The U.S. Air Force portfolio of airfields currently in place in the European theater is the focus of this research project because the United States has an extensive and long-standing inventory of airfields there. Ultimately, this thesis asks whether significant strategic and political changes necessitate a different approach to U.S. military airport management in Europe. The U.S. Air Force should stay in Europe, but it should convert some of its heavy, main operating bases to more flexible, “lighter” installations for both economic and strategic reasons.

**KEYWORDS:** Airfields, bases, installations, main operating bases, forward-operating sites, cooperative-security locations, joint pre-position sites, and en route infrastructure.

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**THE CHALLENGE OF SMALL-SATELLITE SYSTEMS TO THE SPACE-SECURITY ENVIRONMENT**

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During the last two decades, technological advancements to the size and performance of electronics have fostered the development of increasingly sophisticated and smaller satellites. Small satellites, or smallsats as they are commonly referred to, have recorded data on terrestrial and space environments, served as important test beds and risk reducers for emerging space technologies, and provided important hands-on educational opportunities for industry and academia. The decreased cost and improved performance of smallsats have opened up a wide range of space missions at a fraction of the cost of larger satellite systems that would have been unfathomable two short decades ago. The proliferation of smallsat technology opens up a world of new scientific possibilities and unique security challenges as well for all space-faring nations through the potential use of smallsats as anti-satellite (ASAT) systems. This thesis examines the historical development of ASAT systems for the United States, the former Soviet Union, and China and discusses how they have influenced each nation’s space policy. Finally, this thesis will address current efforts to mitigate space weapons, review the implications of smallsat technology development on current space policy, and suggest courses of action to mitigate this emerging space security dilemma.

**KEYWORDS:** Satellites, Smallsats, Space Technology, Anti-satellite systems, Soviet Union, China, Space Policy, Space Weapons, Space Security Dilemma
LESSONS FROM THE PAST: VITAL FACTORS INFLUENCING MILITARY ADVISORS IN KOREA, VIETNAM AND AFGHANISTAN
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Second Reader: Douglas Porch, Department of National Security Affairs

Security assistance and cooperation operations are a pivotal aspect of U.S. foreign and security policy. The United States has a long history of assisting friendly foreign nations with financing, training and equipment as a means of furthering U.S. interests in the region. Inherent within these operations is the role of the military advisor. This thesis represents a historical analysis of advisory operations, specifically systematic case studies of Korea and Vietnam, and provides seven vital factors that have significant influence on an advisor’s ability to effectively promote increased military capabilities of his indigenous counterpart. These vital factors are then be applied to contemporary advisory operations within Afghanistan as a means of critiquing progress thus far. The concluding chapter makes policy reform recommendations for future operations based on the narrative developed throughout the systematic case studies.


ASSESSING THE IMPACT OF SOCIAL MEDIA ON THE 25 JANUARY 2011 EGYPTIAN REVOLUTION
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In the light of the dramatic events of the 25 January 2011 Egyptian Revolution, many media sources gave too much credit to social media and often labeled it as the “Facebook and Twitter revolution” while dismissing the role of Egypt’s most important asset, the Egyptian citizens. This thesis aimed to explore the role and impact of the new social media on sustained social mobilization and the outcome of the 25 January 2011 Egyptian Revolution that led to the ousting of former President Hosni Mubarak. The research showed that social media was a vital tool that enabled preexisting networks to override state repressive measures; however, social media was only one of many tools (or factors) that smoothed the progress of social mobilization, and to some limited extent, had an impact on the outcome of the revolution. In sum, both online and offline tools, tactics and strategies, as well as political opportunities facilitated social mobilization, communication, and organization of Egyptian revolutionaries, and therefore, all impacted the outcome of the revolution.

KEYWORDS: 25 January Egyptian Revolution, Social Media, Egypt.
GETTING SERIOUS ABOUT GAMES—USING VIDEO-GAME BASED LEARNING TO ENHANCE NUCLEAR-TERRORISM PREPAREDNESS
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This thesis proposes the development of a video game platform to increase the public’s knowledge of required protective actions in the event of a nuclear terrorism attack. Current scientific analyses have identified elementary steps the public should take to increase the likelihood of survival in the event of a nuclear terrorism incident; however, a knowledge gap currently exists with regard to the public’s understanding of these required actions. Unfortunately, today’s preparedness initiatives do not have the efficacy required to impact significant improvements in this area. Video games, more specifically a sub-genre of games known as serious games, are uniquely postured to address this knowledge gap. Not only do video games provide a motivating, enriching and engaging educational medium, but also they are unique in that they address the emerging educational needs of today’s games generation, which desires more interactive educational environments since they have been immersed in technology for the majority of their lives. As such, leveraging this technology can help close the current knowledge gap and increase the nation’s resilience to nuclear terrorism.

KEYWORDS: Improvised Nuclear Device, Public Preparedness, Weapons of Mass Destruction, Nuclear Fallout, Game-based Learning, Serious Games, Nuclear Terrorism, Simulation, Games Generation, Video Games, Public Communications, Disruptive Technology, Shelter-in-place, Protective Action Guidance, Nuclear Detonation, Nuclear Attack

JAPAN’S SELF-DEFENSE FORCES AFTER THE GREAT EAST JAPAN EARTHQUAKE: TOWARDS A NEW STATUS QUO
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The Great East Japan Earthquake’s unique scope and the actors involved in the ensuing disaster dispatch has the potential to significantly impact four areas influencing the Self Defense Force’s trajectory: security interests, economic interests, norms, and actors and institutions. Retrenchment, status quo, and remilitarization are all plausible outcomes for the SDF’s trajectory. Understanding what the disasters changed in these four areas is critical in determining the most probable SDF trajectory.

This thesis finds that the SDF will not likely embark on a retrenchment or rapid remilitarization trajectory. Japan’s security and economic interests have not fundamentally changed but rather economic trends in place prior to the disasters were aggravated and its security policy was validated. Japan’s norms were the most fundamentally changed as the SDF emerged from the disasters as the most trusted institution in Japan. Changes will be limited to the fringes of the status quo bordering remilitarization as numerous disincentives restrain the SDF from rapidly moving toward remilitarization. These changes will come about from a growing sense of economic and security pragmatism that results in engaging rather than containing the SDF. Improved civil-military relations, more public support for the SDF’s expanding domestic and international roles, and more deference for the SDF as a useful tool of the state will characterize this new status quo.

KEYWORDS: Japan, Self Defense Forces, JSDF, SDF, Earthquake, Tsunami, Fukushima Dai-ichi, SDF Trajectory, Humanitarian Aid Disaster Relief, U.S.—Japan Security Alliance, Pacifism, Anti-militarism
ROLE OF MILITARY IN POST-CONFLICT SRI LANKA
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Sri Lanka has suffered a violent conflict between the government of Sri Lanka (GoSL) and the Liberation Tigers of Tamil Eelam (LTTE) for nearly three decades. By the time LTTE was crushed in 2009, over 80,000 had been killed, 11,656 Tamil Tigers were either arrested or surrendered, and 2,94,000 people had been internally displaced during the final phase of the conflict. Furthermore, almost all the infrastructure in formerly terrorist-held areas was damaged or destroyed. The GoSL recognized its obligation to provide humanitarian relief; essential services, rehabilitation, and development support to people in LTTE-controlled areas and began post-conflict reconstruction. The GoSL decision to house internally displaced persons (IDPs) prevented much-needed, international-community support during the initial stage of reconstruction. The drain of GoSL resources due to the prolonged conflict and reconstruction in the Eastern Province forced GoSL to use the military to fill gaps in the post-conflict reconstruction process. By doing so, the GOSL was able to resettle 97% of the total IDPs, providing them infrastructure facilities and livelihood opportunities, while reintegrating more than 90% of ex-combatants after their rehabilitation by the end of 2011. This study will examine the way in which the military used its capabilities to shape the reconstruction process.

KEYWORDS: Sri Lanka, Reconstruction, Reintegration, Resettlement, Post-conflict

IMPROVED WEB 2.0 STRATEGY FOR FEMA TO ENABLE COLLABORATION AND A SHARED SITUATIONAL AWARENESS ACROSS THE WHOLE OF COMMUNITY
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The Federal Emergency Management Agency (FEMA) has adopted a “whole of community” approach to emergency management, and seeks to enhance emergency management outcomes through improved preparedness, response, and recovery efforts. The significant amount of time and money required engaging disparate partners, technological and cultural barriers to interoperability, and a lack of training/familiarity with each other inhibits the collaboration necessary to achieve a state of shared situational awareness. A lack of shared situational awareness results in an incomplete operating picture, which complicates decision-making and can lead to inefficient preparedness, response and recovery activities. This thesis explores the terms situational awareness, shared situational awareness, collaboration and common operating picture. It argues that a common operating picture is a state of shared situational awareness achievable only through the process of collaboration, which can be greatly enhanced through a comprehensive Web 2.0 strategy. The thesis reviews FEMA’s current strategy for Web 2.0, and using a structure of appreciative inquiry and successful implementations of Web 2.0 as a guide, proposes strategy adjustments for FEMA. A comprehensive Web 2.0 strategy can foster a culture of collaboration, which will significantly increase FEMA’s ability to achieve enhance emergency management outcomes and support the whole of community. FEMA’s strategy has applicability throughout the homeland security enterprise, as all agencies therein seek a state of shared situational awareness reflected in a common operating picture, and all are considered part of the whole of community.
This thesis suggests that the existing protocols for initial emergency response to a chaotic event do not take advantage of the decision-making skills of front-line responders. Building from a foundation derived from the concepts of reductionism, holism and the Cynefin framework, a purposeful sample of real-world incidents was examined in an attempt to understand and demonstrate how front-line, emergent decision making can positively impact a chaotic emergency scene.

From the research and sampling, a conceptual framework was developed that supports the implementation of a protocol that encourages front-line decision making. The research also identifies a point during the response that signifies entry into the chaotic domain. The REACT framework (respond, engage, act, communicate and transition) is proposed to empower first responders and give them the ability to respond to a crisis when there is not plan.

The REACT framework is capable of being implemented at the lowest level of emergency response agencies. The utilization of this framework allows the decision-making skills of responders to develop incrementally. In addition, this thesis suggests that the framework serves as a mechanism to teach critical thinking and decision making.

KEYWORDS: Reductionism, Holism, Cynefin Framework, Butterfly Effect, Predictable surprise, Starfish and Spider, Black Swan
Using policy option analysis, potential solutions are evaluated and recommendations made to these Indiana institutions.

**KEYWORDS:** Education, Undergraduate Education, Indiana, Public Administration, Homeland Security

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**RE-INTEGRATION OF FORMER LIBERATION TIGERS OF TAMIL EELAM COMBATANTS INTO CIVILIAN SOCIETY IN POST-WAR SRI LANKA**

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The entire nation paid a high price militarily, politically, economically and socially during the past twenty six year old conflict in Sri Lanka however, the Eighteenth of May 2009 marked a significant milestone in the written history of Sri Lanka. The three yearlong Humanitarian Operation conducted by the Sri Lankan Security Forces to liberate civilians from the cruel clutches of the Liberation Tigers of Tamil Eelam (LTTE) terrorists came to an end assigning a total military defeat to the LTTE. As a nation, there is a daunting task with Sri Lanka now, on facing a range of challenges in the post-war era. Above all, much effort is needed to heal the scars of the conflict and to build the Sri Lankan identity. Though the war is over, the remnants of the LTTE may pose a considerable security challenge. Among them are many surrendered combatants of the LTTE who are being rehabilitated and absorbed into the society. Sacred responsibility lies with the government in rehabilitating ex-combatants to ensure a long-term, result-oriented process. Giving its due consideration to the highly sensitive status quo of the issue at the aftermath of its conflict, the Sri Lankan government needs to contribute on its share to rebuild the nation. Therefore, this thesis will dwell on testing the benchmarks expected by the Sri Lankan government in carrying out this process and the outcome so far in meeting the said contesting national requirement, in comparison to other cases of the world.

In this sense, the question arises as to how the programs of reintegration be made successful and what are the potential problems which could be faced in the process of reintegration. In order, this thesis will attempt to identify the questions of Sri Lankan case in comparison to other cases in understanding as to how de-radicalization and re-integration was carried out in these regions against terrorism and how they reached the benchmarks by overcoming weaknesses and lapses.

This research will be established based on comparative case study analysis using secondary data. The data have been accessed through various journals, articles, and books. Secondary research depicts information assembled by literature, broadcast media, publications, and through open source origins. In this research, I will be employing the case study methodology and I would compare the successful and failed cases, of reintegration which took place in different countries and draw lessons from them and make an assessment as to whether some of these lessons and their implications can be applied to the Sri Lankan case.

**KEYWORDS:** Reintegration, Deradicalization, Demobilization, Disarmament, Sri Lanka, Saudi Arabia, Burundi, Yemen, Liberation Tigers of Tamil Eelam, Sri Lankan Civil War, Terrorism, Counterterrorism
COUNTERINSURGENCY PRINCIPLES FOR CONTEMPORARY INTERNAL CONFLICT
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For 26 years, the Sri Lankan armed forces applied counterinsurgency principles (COIN) while fighting against LTTE terrorists, but could not achieve the aim of defeating terrorism. During this period, the LTTE was able to establish itself as a real conventional army. It expanded its capabilities to include a naval wing (sea tiger wing), and an air wing. Its cadres were well motivated to conduct three-dimensional missions (land, air and sea) as well as suicide missions. It was not until the fourth phase—Eelam War IV of the Sri Lanka campaign, however, that the Sri Lankan government was able to establish peace within the country again in 2009. In this context, the researcher examines why success eluded Sri Lanka until the final phase of the campaign, since the same principles (COIN) were followed in all battles. Eelam War IV featured important changes to the Sri Lanka government’s COIN strategy. Those changes incorporated into the outcomes in order to develop analysis on this topic. Further this study will offer a new approach to analyzing the Sri Lanka insurgency. As a further outcome, the paper may provide opportunity for scholarly assessment by decision makers to assess the possibility of modifying counterinsurgency principles based on the Sri Lankan experience.

CREATION OF A UNITED STATES EMERGENCY MEDICAL SERVICES ADMINISTRATION WITHIN THE DEPARTMENT OF HOMELAND SECURITY
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Second Reader: Rudy Darken, Department of Computer Science

Federal administration of this nation's emergency medical services (EMS) has come under increasing criticism, in a post-September 11 world, by many of its stakeholders and constituents. Critics accurately argue that the current construct of federal governance and oversight is impairing the discipline's shareholders from being able to prepare, train, respond and recover appropriately from natural and manmade catastrophic events both locally and nationally. Valid reasons exist to endorse consolidating all the various bodies of federal authority and management into a centric office, the United States Emergency Medical Services Administration (USEMSA).

Many of the EMS non-municipal organizations are poorly represented on a national, state and local scale. This nation’s EMS competence and potential to respond efficiently and productively to any domestic or international catastrophic incident in normal and abnormal environments, regardless of whether the etiology is manmade or natural, requires a skilled, educated and well-equipped workforce.

This thesis evaluates the federal EMS paradigm of the administration for EMS and its complex systems of care and transport and recommends the best model of federal oversight for EMS to meet the challenges set forth in the National Incident Management System, National Response Framework and National Strategy Security plans.

KEYWORDS: Emergency Medical Services, United States Emergency Medical Services Administration, Department of Transportation, Department of Health and Human Services National Incident Management System, National Response Framework and National Strategy Security
HEALTH-SECURITY INTELLIGENCE: ASSESSING THE NASCENT PUBLIC-HEALTH CAPABILITY
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This thesis explores the current state of public health's (HS) intelligence capability across state, local, tribal and territorial (SLTT) jurisdictions through qualitative analysis of current public-health jurisdiction plans for the collection, analysis, product creation, dissemination and programmatic oversight related to public-health inputs into the homeland-security intelligence apparatus. An assessment was conducted using an online plan assessment tool, or PLAT, that allowed jurisdictional public health leadership to provide de-identified responses. This assessment of 25 of the 62 federally funded SLTT public health preparedness programs indicates one impediment to the continued maturation of this new intelligence capability is the lack of codified plans. The results also suggest that while public health programs at the SLTT level do indeed have much room for improvement, there is a burgeoning intelligence capability within public health. However, to sustain and improve this emergent capability will require a national effort to create mission focus and centralized guidance.

KEYWORDS: Public Health, Health Security, Intelligence, Homeland Security

SMALLPOX AS A BIOWEAPON: SHOULD WE BE CONCERNED?
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There is debate in the weapons of mass destruction and bioterrorism literature over whether the threat from smallpox is exaggerated or realistic; however, there has been insufficient evaluation of the factors that indicate whether the threat is valid or overblown. Insufficient weight has been given to whether there are groups or individuals who are capable or have demonstrated the intent to use smallpox as a weapon, which should be key factors in evaluating the level of threat posed by the virus.

To address the issue of the gap in the specific risk assessment of a smallpox attack, the following issues will be considered: (1) capability—whether smallpox is a realistic agent for terrorists to use; (2) motivation—what types of terrorists might pursue smallpox as a bioweapon; and (3) deterrence—whether current U.S. and international policies are likely to impact this decision.

I conclude that the threat the United States faces from a smallpox attack is more remote than is implied by the amount of concern it generates in reports and preparedness exercises. Terrorists are unlikely to be able to master the acquisition, production, weaponization and dissemination of the virus, and would likely pursue other types of weapons.

KEYWORDS: Smallpox, Variola virus, Variola major, Bioterrorism, Biowarfare.
Addressing American fear of discourse on faith, as indicated through evolving American faith narratives, is essential in effectively countering modern day terrorism and to sustaining and securing the republic founded upon unique and enduring democratic principles. This research explores American faith narratives and subsequent relevance to cosmic war; the consequences of American reactions and perceptions to religious extremism; and, the prospect, parameters, and purpose of inclusive faith discourse in the public square. Reactions and realities explored herein are framed through (1) American history of faith in the public square; (2) theoretical world views—how we know the enemy and know ourselves through social-identity theory and positioning theory, and (3) fear of unknown or uncomfortable concepts related to faith as evidenced, through storylines inherent in American faith narratives. Influencing the global perception of America involves imagining the possibilities to ensure that future generations are afforded the American tradition of opportunity and freedom. This involves aggressively initiating public discourse on faith based upon securing diverse religious freedoms and beliefs and democratic principles in such a way that American faith narratives position the United States as a positive global and social influence, thereby, impacting the global terrorists’ threat.

**KEYWORDS:** Religious freedom, social identity theory, positioning theory, faith, religion, narratives, cosmic war, Islamophobia, Islamism, textual analysis, homeland security, fear, religious illiteracy, secularism, discourse, dialogue, theological redirection, omniculturalism, worldview analyst, Establishment Clause, storylines, positions, illocutionary force, globalization, religious terrorism, human rights

**CONCEPT OF OPERATIONS FOR CBRN WIRELESS-SENSOR NETWORKS**

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Wireless-sensor detection is readily accessible, easily deployable, and usable technology that provides public-safety personnel with an early-warning and identification tool in the event of a CBRN incident. This is accomplished by incorporating wireless sensor detection capability into the LAFD’s hazardous-materials operations. Due to the relative ease of use and low cost of deployment, it makes sense that the LAFD employ wireless technology, capitalizing on the advantages.

The question regarding CBRN wireless sensor network capability is whether this technology is suitable, reliable, user friendly, and quickly deployable. Furthermore, will this technology provide critical early warning, detection, and subsequent notification in real time? The goal of this thesis is to determine CBRN wireless sensor detection capability in terms of reliability, deployment, early warning, and notification. The objective is to outline a concept of operations document providing the need structure for incorporating wireless sensor detection capability into public-safety operations.

Through field deployments and exercises using sensor detectors, standardized equipment, and software, the LAFD will have better access to early detection and notification of CBRN material releases. The end result means a more efficient, cost-effective tool that readily detects hazardous products, providing an early warning capability.
Economic sanctions concerning Iran’s nuclear program are not having their intended political effect. Uranium enrichment continues despite sanctions. This thesis argues that international economic “smart” sanctions are failing because they are not altering the relative positions of power between the factional actors in the Iranian political economy, and because the actors who desire to continue enrichment remain in control of the economy and state institutions. The Iranian political economy is a clientelistic state, with differing rival autonomous patron-actors and associated client bases all competing for a larger slice of economic rents. Economic sanctions have failed because the more conservative actors and their clients have entrenched themselves in the economy and control of these rents, thereby diverting the costs of sanctions to their political competitors while simultaneously using sanctions to strengthen their own client base. Research indicates that while stronger economic sanctions could be designed, their chances of success remain unknown. Only a complete and thoroughly enforced embargo on Iranian petrochemical sales, with a simultaneous economic strengthening of reformist actors in the political economy, who are open to a nuclear enrichment policy change, will result in the political goals sanctions are designed to achieve.

KEYWORDS: Iran, Sanctions, Economic Sanctions, Globalization, Ulama, Political Economy, Islamic Economics, Green Movement, Ahmadinejad, IRGC, Uranium Enrichment, WMD, Regime Reform, Iranian Revolutionary Guard Corps, Shia Cleric

THE USE OF AN ENHANCED POLYGRAPH SCORING TECHNIQUE IN HOMELAND SECURITY: THE EMPIRICAL SCORING SYSTEM—MAKING A DIFFERENCE

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This thesis studies the polygraph empirical scoring system (ESS) to determine its potential use in homeland security and the war on terror. The research based its analysis on raw data previously collected by other researchers, who removed identifications from the data and subsequently provided it for study here. The results are described in regards to criterion accuracy; diagnostic capability; proportions of correct, errors, and inconclusive results; and the difference in scoring accuracy based upon participant employment and experience. Twelve scorers in three cohorts scored 22 You-Phase examinations taken from the Department of Defense–confirmed archives. One cohort used the three-position test data analysis (TDA) system, another cohort used the seven-position TDA system, and the final cohort used the ESS TDA system. All TDA systems proved equally capable of diagnostic ability. ANOVAs showed no significant differences between the distributions of ESS and transformed scores. No significant differences were found in decision accuracy with correct, inconclusive, errors rates for ESS scores, and those from the other two TDA systems. That ESS can complement other current hand-score TDA systems is suggested. However, that it could supplant other TDA systems is not confirmable by this study. Further study is recommended.
This thesis investigates the appropriate role of Korean peacekeepers in post-conflict societies and the function of the troop-contributing government of Korea in leading successful peace operations. It examines scholarly discussions regarding peacekeeping success—including conditions and criteria for successful peacekeeping—and applies the factors regarding mandates to Korean peace operations in East Timor and Lebanon. The two country case studies view the results of Korean peace operations from a long-term perspective, applying relevant evaluation factors closely related to the nature of peacekeeping force activities, and avoiding evaluations based on reports from local media and Korean pro-governmental news networks. For successful peace operations, troop-contributing governments should clearly and narrowly order the scope of force activities regardless of the specific field of activity. Despite claims that use of force is needed in more violent contemporary situations, rigorous adherence to the rule of engagement by military contingents will likely create positive outcomes if the force employs friendship-building efforts along with security operations. However, for more fruitful efforts in peacekeeping operations, the military troops and their government should be more deliberate regarding capacity-building activities to most benefit sustainable development and local ownership.

**KEYWORDS:** Korean peacekeeping; Peace operations; Scope of Mandate; Content of Mandate; Peacekeeping success; Civil-military activity; Humanitarian assistance; Friendship-building; Capacity-building; Local ownership; Sustainable development; Evaluation of military contingent’s peace operations

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**BRIDGING THE GULF: A NEW PARADIGM FOR EMERGENCY MANAGEMENT ON AMERICA’S THIRD BORDER**

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The current U.S. government structure for engaging with emergency management issues on the international arena requires fresh analysis and review to determine efficacy and practicality for emerging threats and challenges. Issues of preparedness have taken second seat to humanitarian assistance. Support for key components of national resiliency for any country—preparedness and mitigation—receive only minimal support. Continuing and potentially increasing catastrophic disasters within the homeland’s “backyard” (a term commonly used to refer to the Caribbean/Gulf of Mexico area) will continue to present homeland security issues far into the future. A commitment to investment in preparedness, as well as new structures for initial support following a major disaster, will relieve pressure on the United States—and the international community—to invest heavily in costly humanitarian assistance. At the same time, it will serve to strengthen the national regimes in the area and strengthen the regional resiliency that well serves the hemisphere at large. It is safe to say that the
traditional approach of the United States government has had a paternalistic flavor to it, jumping in to help after a crisis, but leaving under-developed and under-resourced countries to fend for themselves in developing organic capabilities to be ready for the next disaster. By developing a broader U.S. government capacity to address the fuller cycle of emergency management issues—preparedness, mitigation, response and recovery—in partnership with our neighboring countries within and bordering the Gulf of Mexico, we will be better prepared to handle the future catastrophes that are sure to come. By authorizing and resourcing the Federal Emergency Management Agency (FEMA) to operate on behalf of the American people outside the domestic national borders, a new paradigm for inter-agency emergency management can be developed that achieves the goal of strengthened hemispheric disaster resiliency.

**KEYWORDS:** Emergency Management, Caribbean, Central America, Disaster, Preparedness, Catastrophic, Collaboration, FEMA, USAID, OFDA, Response.

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**MARITIME LAW ENFORCEMENT: A CRITICAL CAPABILITY FOR THE NAVY?**

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Master of Arts in Security Studies–March 2012  
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Second Reader: Jeffery E. Kline, Department of Operations Research

This thesis asks the questions, Are our maritime organizations organized and employed properly to ensure our nation’s maritime security; and should maritime law enforcement be considered a critical capability for the Navy. Maritime security is not only a priority mission in the national and naval strategy, but for the international maritime community as well. It is established that law enforcement presents the best means to achieve maritime security. By accepting the maritime law enforcement role, the Navy may help close maritime security gaps not only in the homeland but also on the maritime global commons. Therefore, it is important to understand the effects of the Navy’s lack of law-enforcement powers on maritime security operations and maritime security as a whole. The thesis identifies gaps, shortfalls, and deficiencies in both the Navy’s maritime security operations, and maritime security as a whole, due to the restrictions on law enforcement roles. It also analyzes the concerns associated with increased law enforcement and maritime security roles for the Navy by covering the operational, fiscal, and warfighting readiness costs associated with greater maritime security roles. Together this will help to determine whether the Navy should consider law enforcement as a critical capability and resource it as such.

**KEYWORDS:** Maritime Security, Homeland Security, Defense, Navy, Coast Guard, Maritime Law Enforcement, Posse Comitatus, DoD, Maritime Interdiction, Theater Security Cooperation

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**RESILIENT COMMUNICATION: A NEW CRISIS COMMUNICATION STRATEGY FOR HOMELAND SECURITY**

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Second Reader: John Bilotta, DoD Contractor

Current crisis communication plans and guidance at all levels of government focus almost exclusively on communication during a crisis, rather than a comprehensive approach that also addresses the timeframe well before and well after a disaster. Furthermore, existing crisis communication strategy does not include approaches to enhance resiliency in individuals and communities affected by disaster.

A case study of the 2007 Greensburg, Kansas, tornado assessed the crisis communication strategy sur-
rounding the disaster to assist in the development of a new comprehensive crisis communication strategy for homeland security.

The case study revealed the need for homeland security leaders to reframe crisis communication by considering disasters as the norm, not a rarity. The case study also found significant benefits to utilizing a complex systems approach in crisis communication strategy, specifically the pragmatic complexity model.

New crisis communication approaches were recommended including a public partnership approach and a resilient messaging/survivor psychology approach.

The research recommendations also included specific before and after message themes to engage the public and help them become more resilient.

The case study and research concluded a state-level strategy would be most beneficial and would allow specific messaging to be delivered by leaders familiar to the community affected.

**KEYWORDS:** crisis communication strategy, emergency communication plan, resilient messaging, resilient communication, Greensburg tornado

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Master of Arts in Security Studies–March 2012

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

For the latter half of the past decade, the U.S. Army has been engaged in persistent asymmetric warfare. During this period, army organizations have varied in the degree to which they have innovated doctrinally and technologically to confront this new reality. At the broadest level, the army has innovated considerably. However, at the combat brigade level, we observe variation across medical and logistics units, critical for providing support for combat operations. This thesis explains this variation.

Several authors propose that units learn and innovate primarily during wartime or peacetime, and they do so from either a “top-down” or bottom-up methodology. Yet such methods of learning do not adequately explain variations between respective levels of innovation in which logistics forces within combat brigades have seemingly adapted more rapidly than their medical counterparts. This thesis suggests that another factor, organizational complexity, explains why the brigade support medical company has not adapted as rapidly as its logistics counterparts within the support battalion (BSB) structure.

**KEYWORDS:** logistics, medical, BSB, BSMC, support battalion, military innovation, combat brigade, sustainment, military adaptation, doctrine, U.S. Army, ambulance, Stryker
<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Organization</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abunaz, 1st LT Erkan</td>
<td>Turkish Air Force</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Acord, LT Christian G.</td>
<td>USN</td>
<td>9</td>
<td></td>
</tr>
<tr>
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<td>United Arab Emirates Navy</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Antilllon, LCDR Oscar D.</td>
<td>USN</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Asche, LT Michael J.</td>
<td>USN</td>
<td>9</td>
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</tr>
<tr>
<td>Atwater, Paul A.</td>
<td></td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Barsh, Jennifer L.</td>
<td></td>
<td>82</td>
<td></td>
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<tr>
<td>Bayram, 1st LT Soner</td>
<td>Turkish Air Force</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Becker, LT John P.</td>
<td>USN</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Beech, George M.</td>
<td></td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Bell, LT Andrew T.</td>
<td>USN</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Bernard, Gregory M.</td>
<td></td>
<td>83</td>
<td></td>
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<tr>
<td>Bernard, LT Benjamin J.</td>
<td>USN</td>
<td>62</td>
<td></td>
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<tr>
<td>Betts, Willard</td>
<td></td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Blomberg, LT Eric J.</td>
<td>USN</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Boothe, LT BJ S.</td>
<td>USN</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Bottolfson, LT Brent A.</td>
<td>USN</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Bryant, Lucas S.</td>
<td></td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Chaudhry, Capt Naghman</td>
<td>Pakastani Navy</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Chilcoat, Capt Kenneth H.</td>
<td>USAF</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Childers, LT Scott</td>
<td>USN</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Christensen, Maj Adrian S.</td>
<td>USAF</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Clarkson, LT Robert D.</td>
<td>USN</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Cleary, LCDR Robert J.</td>
<td>USN</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Colvin, LT Walter</td>
<td>USN</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Cowden, LT Bradley T.</td>
<td>USN</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Cox, Alan Thomas</td>
<td></td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Crecque, Capt Henry O.</td>
<td>USMC</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Crewes, LT Monique N.</td>
<td>USN</td>
<td>9</td>
<td></td>
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<tr>
<td>Crews, LT Jason C.</td>
<td>USN</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Criswell, Deanne B.</td>
<td></td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Day, Michael</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>DeBaun, LT Matthew B.</td>
<td>USN</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>DeMarco, Capt Adam W.</td>
<td>USAF</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Donnelly, Timothy S.</td>
<td></td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Dutta, Sunil</td>
<td></td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>Eby, Charles A.</td>
<td></td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Elson, LCDR Jay F.</td>
<td>USN</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Erhardt, Maj Bruce J., Jr.</td>
<td>USMC</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Erwin, Stephanie K.</td>
<td></td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Filiz, LT Caner</td>
<td>Turkish Navy</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Furlough, Lt Col Daniel C.</td>
<td>USAF</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Futch, LT Thomas D.</td>
<td>USN</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Gabriel, LT James Gregory</td>
<td>USN</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Gallon, Maj Daniel A.</td>
<td>USAF</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Gardner, LT David T.</td>
<td>USN</td>
<td>91</td>
<td></td>
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<td>Gawhry, LT Lilas N.</td>
<td>USN</td>
<td>91</td>
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<td>Gehrke, LT Keith A.</td>
<td>USN</td>
<td>11</td>
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<td>Gillies, Capt Shane D.</td>
<td>USAF</td>
<td>50</td>
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<td>Gorman, Chad M.</td>
<td></td>
<td>92</td>
<td></td>
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<tr>
<td>Gray, LT Ryan M.</td>
<td>USN</td>
<td>17</td>
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<td>Hasa, Capt Petr J.</td>
<td>USAF</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Heiss, CDR Kevin L.</td>
<td>USN</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Herath, Lt Col Ihalagedera</td>
<td>Sri Lankan Army</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>Herschelman, Maj Philip R.</td>
<td>USMC</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Hines, LT Jonathan T.</td>
<td>USN</td>
<td>17</td>
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<td>Hiscock, Kyle W.</td>
<td></td>
<td>92</td>
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<td>Hovey, Maj Erik P.</td>
<td>USMC</td>
<td>35</td>
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<td>USN</td>
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<td>Jacobs, LT Paul A.</td>
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<td>Jean-Pierre, LT Markelly</td>
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<td>32</td>
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<td>Jensen, LT Timothy</td>
<td>USN</td>
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<td>Jett, Maj Andrew M.</td>
<td>USAF</td>
<td>15</td>
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<td>Johnson II, Samuel Rhodes</td>
<td>USA</td>
<td>93</td>
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<td>Jones, LT Levi C.</td>
<td>USN</td>
<td>44</td>
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<td>Kalapuge, Lt Col Lakshan</td>
<td>Sri Lankan Army</td>
<td>95</td>
<td></td>
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<tr>
<td>Kitchin, Maj Christopher D.</td>
<td>Australian Army</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Knapp, LCDR Kathleen L.</td>
<td>USN</td>
<td>36</td>
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<td>1</td>
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<td>USN</td>
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<td></td>
<td>94</td>
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<td>Manage, Lt Col Nishantha</td>
<td>Sri Lankan Army</td>
<td>96</td>
<td></td>
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<td>Mancini, CDR Steven</td>
<td>USN</td>
<td>56</td>
<td></td>
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<tr>
<td>Mancini, Steven</td>
<td></td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Martinez, Capt Luis E., J.</td>
<td>USAF</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Matar, Capt Yusuf M.</td>
<td>Bahraini Air Force</td>
<td>66</td>
<td></td>
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<tr>
<td>Matthias, LCDR Robert D.</td>
<td>USN</td>
<td>29</td>
<td></td>
</tr>
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<td>McBride, Maj Trey M.</td>
<td>USMC</td>
<td>36</td>
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<td>McCoy, LT Matthew E.</td>
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<td>7</td>
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<td>USN</td>
<td>44</td>
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<td>McGovern III, Philip P.</td>
<td></td>
<td>96</td>
<td></td>
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<tr>
<td>Megas, LT Dimitrios</td>
<td>Hellenic Navy</td>
<td>12</td>
<td></td>
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<tr>
<td>Michalaros, LCDR Anastasios</td>
<td>Hellenic Navy</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Minarcine, Scott</td>
<td></td>
<td>97</td>
<td></td>
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<tr>
<td>Mock, LCDR Philip J.</td>
<td>USN</td>
<td>66</td>
<td></td>
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<tr>
<td>Murnane, LCDR Mark</td>
<td>USN</td>
<td>56</td>
<td></td>
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<td>Murphy, LT Corey C.</td>
<td>USN</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Musson, LT Gail C.</td>
<td>USN</td>
<td>97</td>
<td></td>
</tr>
</tbody>
</table>
N
Nations, Julie 98
Neboshynsky, LT Christopher M., USN 61
Neff, LT Justin M., USN 13
Nelson, Robert W. 98
Ng, Chee Wee 23
Ng, Mun Wai Raymond 21
Nowel, LT Jason T., USN 37

O
Onder, Capt Akif, Turkish Army 38
Ongun, Capt Kursat, Turkish Army 38

P
Panczenko, Capt Jason A., USAF 75
Pate, LT Bradley C., USN 39
Phillips, Capt Wellington V.G., USAF 77
Plumer, LCDR Andrew G., USN 99
Ponder, LT Jason K., USN 45
Pryor, Benjamin A. 71

R
Rank, LT Emory, USN 39
Raptis, LCDR Konstantinos, Hellenic Navy 57
Ray, LCDR Heather B., USN 40
Reamy, Capt Stephen, USMC 41
Reber, LT Ethan A., USN 62
Roberts, LT Donald A., USN 67
Robertson, Bruce P. 99
Ronny, Ang Toon Yiam 75
Rozak, Capt Edward J., USAF 51

S
Schmidt, LCDR Juli, USN 41
Schmidt, LT Brandon K., USN 69
Schramm, CDR Harrison, USN 61, 63
Shin, Capt Seongkyoon, Korean Army 100
Sims, LT Todd E., USN 18
Slaten, Andrew R. 100
Solano, Capt Mario L., USMC 67
Someira, LCDR Kleber, Brazilian Navy 12
Somnhot, LT Parina, USN 45
Sonnenberg, Capt Dirk C., USN 101
Strong, Capt Greg J., USAF 52
Sullivan, CDR Joseph, USN 62
Sulog, LCDR Amy Nodine B., USN 2
Svatek, LCDR Mike E., USN 57

T
Tan, Hwee Meng 13
Tan, LCDR Meng Hwee, Singaporean Navy 46
Tanner, Douglas C. 14
Torun, 1st LT Bulent, USN 31
Trampp, LT David A., USN 58

V
Van Bourgondien, Capt Jeffery, USMC 2
Washington, LT Ernest O., USN 25
Watson, LT David H., USN 59
Watson, Sharon L. 101
Wekell, MAJ Douglas P., USA 102
Williford, LT Bradley J., USN 14
Willis, Capt Ryan S., USAF 52
Wireman, Capt Christopher S., USAF 53
Woodson, LT John, USN 61
Yearby, Capt Shedrick Dashun, USMC 3
FACULTY INDEX

A
Agrawal, Brij N. 75
Alves, Fabio 21
Arkes, Jeremy A. 34

B
Bach, Robert 82, 96, 100
Barma, Naazneen H. 100
Barreto, Alberto 25
Barrett, Frank 27
Baylouny, Anne-Marie 89
Becker, William 61
Bellavita, Chris 101
Bellavita, Christopher 81, 86, 87, 93, 94
Bellavita, Chris 94
Bell, Michael M. 51
Bergin, Richard 83, 86, 93, 98
Beverly, Robert 11
Bilotta, John 101
Black, Peter G. 58
Boerlage, Col Andrew P., USAF (ret.) 52
Bonesteel, Raymond 77
Brannan, David 82, 88, 98
Brewe, Luke N. 44
Brewer, Luke N. 43
Brook, Douglas 38
Brophy, Christopher 75
Brown, Gerald G. 66
Butler, Jon T. 7, 18
Buttrex, Samuel E. 65

C
Chatterjee, Anshu 84, 96
Chung, Timothy H. 10
Clark, Paul C. 13
Clunan, Anne L. 97
Cook, Glenn R. 25
Crawford, Alice 32
Cunha, Jesse 31, 37

D
Dahl, Erik 85, 101
Darken, Rudi 10
Dell, Robert F. 66
Dinolt, George 14
Dobrokohodov, Vladimir 43
Doyle, James D. 49
Doyle, Richard 2
Du Toit, Noel 44

E
Ear, Sophal 100
Eitelberg, Mark J. 1, 39
Elsberry, Russell L. 49, 52
Emdee, Jeffery 75

F
Farmer, Joseph 45
Fernandez, Lauren 83
Franck, Raymond E. 2
Fricker, Ronald D. 67
Fulp, J.D. 10, 11

G
Gallup, Shelley 29
Gannon, Anthony 45
Gates, William 36
Gibson, John H. 9, 13, 14
Greenshields, Brian H. 15
Gresalfi, Michael J. 92
Guest, Peter 57
Gurminder Singh 9

H
Hacker, Joshua 53
Hacker, Joshua P. 49
Hafez, Mohammed 91, 96
Halladay, Carolyn 90
Harr, Patrick A. 49, 51, 52, 57
Hatch, William 1, 33, 35, 36, 38, 39, 40, 41
Herbers, Thomas H. C. 59
Hobson, Garth 45
Horner, Douglas 43
Huffmire, Ted 10, 12
Hughes, Wayne P. 66
Huynh, Thomas V. 75

I
Iatrou, Steven 25
Irvine, Cynthia E. 13

J
Jaskoski, Maiah 102
Jasper, CAPT Scott, USN (ret.) 90
Jenn, David C. 21
Johnson, Thomas 91
Josefek, Robert 82, 89
Julian, Alexander L. 17

K
Kadhim, Abbas 81, 91
Kahn, Feroz H. 84
Kapolka, Daphne 23
Karunasiri, Gamani 21
Kennedy, Quinn 61, 63
Kline, Jeffery E. 101
Knopf, Jeffrey W. 97
Kragelund, Sean 43
Krapohl, Donald J. 99

L
Langford, Gary 77
Levin, Timothy E. 12
Looney, Robert E. 81, 84, 99
Lucas, Thomas W. 67

M
MacKinnon, Douglas J. 27, 29
MacMahan, Jamie 59, 73
Matthews, David F. 2, 71
McCauley, Michael 61
McDowell, Perry 62
McEachen, John 17
Mehay, Stephen L. 31, 32, 34, 35, 37, 40
Menon, Sarath 44
Merideth Bastiani 82
Meyer, David 50
Mildner, John 14
Miller, Alice L. 92
Miller, Patrick 82
Moltz, James Clay 90
Moore, Richard W. 51, 55, 57
Morag, Nadav 87
Murphree, Tom 50, 52, 55, 57
Myung, Noah 36

N
Naegle, Brad R. 71
Nelson, Douglas 75
Nieto-Gomez, Rodrigo 83, 85, 100
Nussbaum, Daniel 1
Nuss, Wendell A. 50, 51, 53, 55

O
Olsen, Richard C. 73
Olwell, David H. 77
Oriti, Giovanna 17
Osswald, Sebastian 43, 45
Otani, Thomas 9, 12

P
Pema, Elda 31, 37, 38, 39, 40
Pfeiffer, Karl D. 55
Piombo, Jessica 86
Porch, Douglas 91, 93
Pratkanis, Anthony 25

R
Roberts, Ben 32, 33, 40
Rollins, John 81, 83
Rowe, Neil C. 11, 14
Russell, James A. 89, 102

S
San Miguel, Joseph 1
Schrock, LT Christopher T., USN 29
Seagren, Maj Chad, USMC 32, 33, 35, 36, 66, 67
Sepp, Kalev I. 15
Shatnawi, Dina 38
Shattuck, Nita L. 67
Shen, Yu-Chu 31, 37
Simeral, Robert 97
Simon, Cary 41
Singer, Andrew 85
Singh, Gurminder 9, 13, 14, 28
Smith, Kevin 23
Smith, Paul Jonathan 89
Sotomayor, Arturo 84, 86, 93
Springborg, Robert 99
Stanica, Pantelimon 7, 18
Steckler, Brian 27, 28
Stoker, LCDR Carol, USN 35
Strindberg, Anders 88, 98
Supinski, Stan 87
Su, Weilian 18

T
Thompson, LCDR Keith B., USN 58
Tsypkin, Mikhail 90
Tummala, Murali 17

U
McCay, LT Matthew E. 18

W
Wang, Chong 2
Wang, Qing 50, 58
Wang, Shouping 50
Weiner, Robert J. 92
Welch, William J. 29
Whitaker, Lyn R. 65
Wollman, Lauren 92, 94, 97, 98, 99
Woodbury, Glen 87

Y
Yakimenko, Oleg 44
Yang, Ji Hyun 61, 63
Young, Joel D. 11
Yun, Xiaoping 18
Yu, Warren 12
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