

Naval Postgraduate School
Monterey, California 93943-5138



NPS-09-07-005

Compilation of Thesis Abstracts

June 2007



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

PREFACE

This publication contains abstracts of unrestricted or unclassified theses submitted for the degrees doctor of philosophy, master of business administration, master of science, and master of arts for the June 2007 graduation. Classified and restricted distribution abstracts are listed on the NPS SIPRnet.

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

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

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

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

INTRODUCTION

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:

Provide relevant and unique advanced education and research programs in order to increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the United States.

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

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

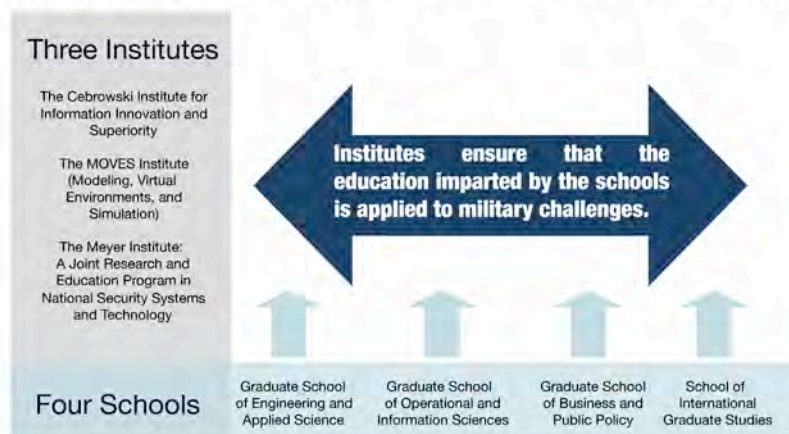
- maintains upper-division course content and programs at cutting edge;
- challenges students with creative problem solving experiences on DoD-relevant issues;
- advances DoN/DoD technology;
- solves warfare problems; and
- attracts and retains quality faculty.

Academic Programs

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

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

Integrated • Systems Oriented • Flexible • Partnered for Strength



INTRODUCTION

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 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 Engineering/Electrical Engineering
- Space Systems Engineering
- Space Systems Operations
- Systems Engineering
- Systems Engineering Management
- Undersea Warfare
- Underwater Acoustic Systems

Graduate School of Business and Public Policy

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

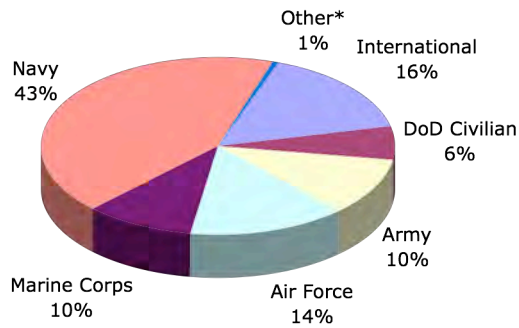
School of International Graduate Studies

- Civil–Military Relations
- Combating Terrorism: Policy, Strategy
- Defense Decision Making and Planning
- Homeland Defense and Security
- 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

Students

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government, and military officers and government civilian employees of other countries. The resident degree/subspecialty student population for June 2007 is shown in Figure 1 on the following page.

INTRODUCTION



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

**Figure 1: Resident Degrees/Subspecialty Student Population for June 2007 (1585 Total)
(Total Enrollment, Resident and Nonresident: 2511)**

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 Degrees

National Security Affairs
Security Studies

Master of Business Administration

Master of Science Degrees

Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Combat Systems Technology
Computer Science
Computing Technology
Contract Management
Defense Analysis
Electrical Engineering
Electronic Warfare Systems Engineering
Engineering Acoustics
Engineering Science
Human Systems Integration
Information Operations
Information Systems and Operations
Information Technology Management
Information Warfare Systems Engineering
Management
Materials Science and Engineering
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography

Physics

Product Development
Program Management
Software Engineering
Space Systems Operations
Systems Analysis
Systems Engineering
Systems Engineering Analysis
Systems Engineering Management
Systems Technology

Engineer Degrees

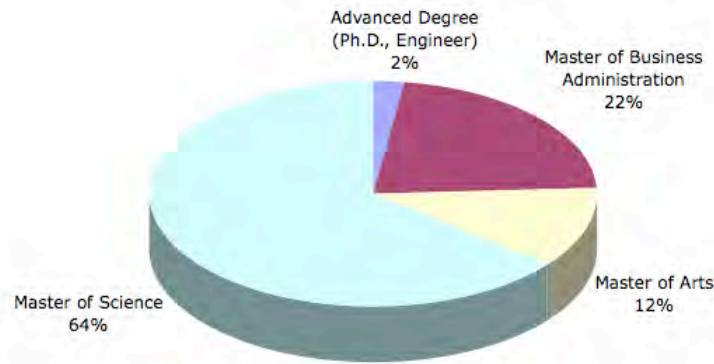
Astronautical Engineer
Electrical Engineer
Mechanical Engineer

Doctor of Philosophy

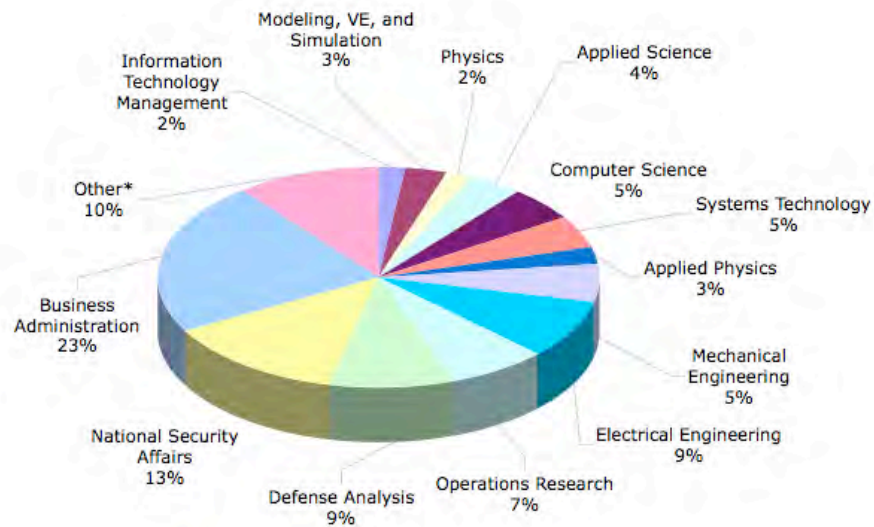
Applied Mathematics
Applied Physics
Astronautical Engineering
Computer Science
Electrical Engineering
Engineering Acoustics
Information Sciences
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Security Studies
Software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

INTRODUCTION

In June 2007, 278 degrees were conferred. Figure 2 indicates distribution by type, Figure 3 by degree area.



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



*Other—Advanced Degrees: Ph.D. Electrical Engineering (3), Ph.D. Physics (1), Ph.D. Software Engineering (1). Engineer's degree: Electrical Engineer (1). M.S. and M.A. degrees: Applied Mathematics (1), Contract Management (1), Engineering Acoustics (4), Engineering Science (1), Information Operations (3), Leadership and Human Resource Development (3), Management (3), Meteorology (2), Physical Oceanography (3), Program Management (4), Security Studies (3), Systems Engineering (1)

**Figure 3. Degrees Conferred in June 2007
(278 Degrees Conferred)**

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

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

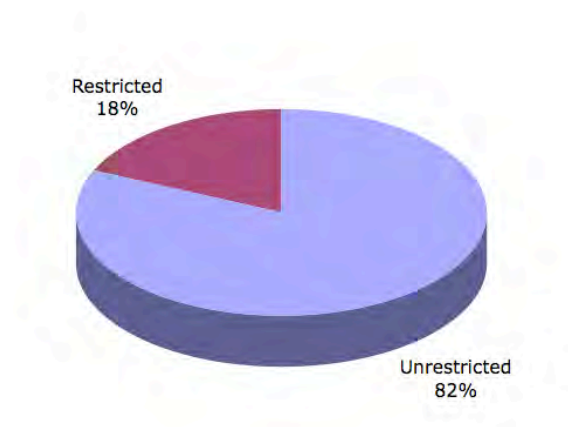


Figure 4. Classification of Theses

TABLE OF CONTENTS

ADVANCED DEGREES

DOCTOR OF PHILOSOPHY

Enhanced Radio Frequency (Rf) Collection with Distributed Wireless Sensor Networks	3
Computational Modeling of the Spatial Distribution and Temporal Decay of Geomagnetically Trapped Debris of a High-Altitude Nuclear Detonation	3
Rapid Prototyping of Robotic Systems	4
Robust Model-Based Fault Diagnosis for a Direct-Current, Zonal, Electrical-Distribution System	4
Energy Conservation in Wireless-Sensor Networks	5

ELECTRICAL ENGINEER

Distributed Algorithms for Beam-Forming in Wireless-Sensor Networks	7
---	---

MASTER OF BUSINESS ADMINISTRATION

Private Military Firms: Historical Evolution and Industry Analysis	11
Feasibility Analysis of an All-Volunteer Armed Force in Turkey	11
Feasibility Study and Cost-Benefit Analysis of Thin-Client, Computer-System Implementation Onboard United States Navy Ships	12
Navy Career-Sea Pay: Is It Still a Viable Compensating Wage Program? A Historical and Financial Analysis	12
Team Formation Under Normal-Versus Crisis Situations: Leaders' Assessments of Task Requirements and Selection of Team Members	13
Applying Financial Portfolio Analysis to Government Program Portfolios	13
The Remaking of an American Icon: A Naval-Postgraduate-School Graduate Case Competition	14
Developing an Acquisition Strategy for the Colombian Navy's New Strategic Surface Ships	14
A Game-Theory View of the Relationship between the U.S., China, and Taiwan	15
Estimating the Total Cost of a Personnel Security Clearance	15
"Helios Dynamics:" A Potential Future Power Source for the Greek Islands	15
Applicability Analysis of Performance Based Logistics Implementation for the U.S. Army Stryker Armored Vehicle to Improve Turkish Army Weapon System Support	16
Study of the Hellenic Military's Education-Buying Process Using Trend Analysis to Identify Determinant Factors	16
Worldwide Husbanding-Process Improvement: Comparative Analysis of Contracting Methodologies	17
The Impact of Declining Defense Budgets on the Japanese Maritime Self-Defense Force	17
Budget Scoring of Alternative Financing Methods for Defense Requirements	18
An Analysis of the Joint Modular, Intermodal, Distribution System	18
Cost in Higher Education	19
The Determination of Nursing-Manpower Requirements in Humanitarian-Assistance Missions for Hospital Ships	19
Foreign Military Sales-Trend Analysis: Impacts on the Future with Application to Taiwan	19
An Analysis of Manpower Requirements for the United States Marine Corps' Tiers II and III Unmanned-Aerial-Systems Program	20
Using an Experimental Approach to Improving the Selective Reenlistment-Bonus Program	20
The Nature of Department-of-Defense Reprogramming	21
A Statistical Analysis of Los-Angeles Class Operating/Operational-Target Expenditures Among Pacific-Fleet Homeports	21
Crossing the Technology-Adoption Chasm in the Presence of Network Externalities: Implications for the Department of Defense	22
Evaluation of Contract Management Processes in the United Nations for Acquiring Peacekeeping Operations/Services	22
A Statistical Analysis of the Career Intentions of Mobilized, Enlisted, Selected Reservists	23
Evaluation of Naval Aviation Enterprise Airspeed's Generation of Measurable Cost Savings and Reinvestment for Recapitalization of the Future Navy and Marine Corps	23

TABLE OF CONTENTS

MASTER OF SCIENCE

APPLIED MATHEMATICS

Realizable Triples in Dominator Colorings.....	27
--	----

APPLIED PHYSICS

Integrating the Free-Electron Laser on an All-Electric Ship.....	29
A Hybrid, Large-Scale, Wireless-Sensor Network for Real-Time Acquisition and Tracking.....	29
Track-Score Processing of Multiple, Dissimilar Sensors.....	30
An Investigation of the Static-Force Balance of a Model Railgun.....	30
Modeling of High-Frequency Acoustic Propagation in Shallow Water.....	31
Modeling and Implementation of Proportional-Integral-Derivative Control for Autonomous Robots.....	31

APPLIED SCIENCE

Biological-Terrorism Preparedness: Evaluating the Performance of the Early Aberration Reporting System's Syndromic-Surveillance Algorithms.....	33
Analysis of Junior Reserve Officer Training Corps' Participation and Effects on First-Term Attrition, Promotion, and Reenlistment.....	33
A Comparative Analysis of Multivariate Statistical Detection Methods Applied to Syndromic Surveillance.....	34
A Conceptual Framework for the U.S. Army's Tactical-Wheeled-Vehicle Optimization Model.....	34
Optimal, Randomized, Surveillance Patterns to Detect Intruders Approaching a Military Installation.....	35

COMPUTER SCIENCE

An OSKit-Based Implementation of Least-Privilege, Separation-Kernel Memory Partitioning.....	37
Testing Automation Tools for Secure Software Development.....	37
Counterintelligence through Malicious-Code Analysis.....	38
Alloy Experiments for a Least-Privilege Separation Kernel.....	38
Mapping Autonomous Systems's Router-Level Topology in IPv6.....	38
VoIPNET: A Software-Based Communications Tool for Low-Bandwidth Networks.....	39
A New Sufficient Condition for Robust Interdomain Routing.....	39
The Value of Numerical Forecast Products in Improving Tactical Air-Delivery Methods.....	40
Sensor-Failure Detection through Introspection.....	40
Preliminary Analysis of a Trusted-Platform-Module Initialization Process.....	41

CONTRACT MANAGEMENT

A Handbook for Contracting Officers.....	43
--	----

DEFENSE ANALYSIS

Transforming Change in the Military: A Systems Approach.....	45
Combating Terrorism in the Brazilian Tri-Border Area: A Necessary Law-Enforcement Strategic Approach.....	45
A Non-Conventional Interdiction Strategy for the Global War on Terrorism.....	46
Alternative Strategies for Iraq.....	46
Game Theory: Toolkit and Workbook for Defense-Analysis Students.....	47
Rethinking Militias: Recognizing the Potential Role of Militia Groups in Nation Building.....	47
Mortus Discriminatus: Procedures in Targeted Killing.....	48
Satan vs. Satan: The Use of Black PSYOP to Regain the Tactical Initiative in the Counterinsurgency Fight.....	48
Finding the Missing Link to a Successful Philippine Counterinsurgency Strategy.....	49
Xenophon's <i>Anabasis</i> : Lessons in Leadership.....	49
The Cycle of Reciprocity: A Social-Capital Intervention Strategy for Security, Stability, Transition, and Reconstruction.....	50
Optimizing Army Special-Forces Leaders in a Global Counter-Insurgent Network.....	50
Building a Virtual Cultural-Intelligence Community.....	51

TABLE OF CONTENTS

ELECTRICAL ENGINEERING

Feasibility of a Dynamic-Data-Rate Satellite Link for Inmarsat	53
Performance of Wireless, Unattended, Sensor Networks in Maritime Applications.....	53
Performance Analysis of IEEE 802.11g Trellis-Coded Modulation Waveforms Transmitted Over a Channel with Pulse-Noise Interference	54
Indium-Gallium-Nitride, Multijunction, Solar-Cell Simulation Using Silvaco Atlas	54
Independent Component Analysis by Entropy Maximization (Infomax)	55
Linear and Planar Array Formation in Wireless Sensor Networks.....	55
A Hybrid, Large-Scale, Wireless-Sensor Network for Real-Time Acquisition and Tracking.....	55
Multistage Security Mechanism for Hybrid, Large-Scale, Wireless-Sensor Networks	56
Performance Analysis of a Variable Data Rate Trellis-Coded Modulation Waveform Transmitted Over a Channel with Additive White Gaussian Noise and Pulse-Noise Interference.....	57
Real-Time, Speech-Recognition System for Robotic-Control Applications Using an Ear Microphone	57
Control of a System in the Presence of Flexible Modes.....	58
Distributed Algorithms for Beam-Forming in Wireless-Sensor Networks	58
Track-Score Processing of Multiple Dissimilar Sensors	59
Extending the Range of the 802.11g WLAN through Improved Synchronization Techniques.....	59
Optical Flow Analysis and Kalman-Filter Tracking in Video-Surveillance Algorithms	60
PC104 Control-Environment Development and Use for Testing the Dynamic Accuracy of the MicroStrain 3DM-GX1 Sensor.....	60
Effects of Wireless Channel, Signal Compression, and Network Architecture on Speech Quality in VoIP Networks	60
Filter-Bank Approach to the Estimation of Flexible Modes in Dynamic Systems.....	61
Partial Band Jamming Against 802.16a.....	61

ENGINEERING ACOUSTICS

Improving the Visual Perception of Sonar Signals with Stochastic Resonance	63
--	----

INFORMATION OPERATIONS

The Makara of Hizballah: Deception in the 2006 Summer War.....	65
Homegrown Terror: The United Kingdom as a Case Study	65

INFORMATION TECHNOLOGY MANAGEMENT

A Case Study on the Need for and Availability of Patient-Tracking Systems.....	67
The Defense Messaging System in the Naval, Regional, Enterprise-Messaging-System Environment: Evidence that Size Does Matter in Department of Defense Business-Process Engineering	67
The Use of Collaborative and Three-Dimensional Imaging Technology to Increase Value in the SHIPMAIN Environment of the Fleet-Modernization Plan	68

LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

An Exploratory Study of Persuasive Influences on Midshipman Service Selection at the United States Naval Academy: Comparing Service Selection for the Submarine Force and the United States Marine Corps.....	69
How Is the United States Naval Academy Developing and Preparing Surface-Warfare Officers: A Needs Analysis of the Surface-Warfare-Officer “Leadership Capstone” Course	69
An Exploratory Study of the United States Naval Academy’s Engineering Curriculum.....	70

MANAGEMENT

The Sequential, Self-Selection Auction Mechanism for Selective Reenlistment Bonuses: Potential Cost Savings to the U.S. Marine Corps	71
The Marine Corps’ Joint-Officer Management Policy and O-7 Joint-Service-Officer Requirements	71
Manpower Staffing, Emergency-Department Access, and Consequences to Patient Outcomes.....	72

MECHANICAL ENGINEERING

Stall-Precursor Determination of an LM-2500 Gas Turbine.....	73
Oscillations of a Multi-String Pendulum	73
Heat-Conduction Analysis of Randomly Dispersed, Single-Walled, Carbon Nanotubes.....	74

TABLE OF CONTENTS

Analytical Modeling of Composite-to-Composite (SCARF) Joints in Tension and Compression	74
Finite-Element and Molecular-Dynamics Modeling and Simulation of the Thermal Properties of Nanocomposites	74
Optimal Trajectory Generation for Multiple-Asteroid Rendezvous	75
Experimental Investigation of High-Pressure, Steam-Induced Stall of a Transonic Rotor	75
Application of Artificial-Boundary Conditions in Sensitivity-Based Updating of Finite-Element Models	76
Calculating Required Substructure Damping to Meet Prescribed System Damping Levels	76
Real-Time Implementation of an Asynchronous Vision-Based Target-Tracking System for an Unmanned, Aerial Vehicle	76
The Enhancement of Composite SCARF-Joint Interface Strength through Carbon-Nanotube Reinforcement	77
Effects of Laboratory Rolling Conditions on Continuously Cast AA5083	77
METEOROLOGY	
An Assessment of the “WorldWide Merged-Cloud Analysis” Using Interactive Graphics	79
A Satellite-Based Fog Study of the Korean Peninsula	79
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION	
A Venture-Capital Mixed Model for the Acquisition of Defense Software Products	81
Investigating Team Collaboration in the Fire Department of New York Using Transcripts from September 11, 2001	81
Navy Requirements for Controlling Multiple Off-Board Robots Using the Autonomous, Unmanned- Vehicle Workbench	82
An Analysis of Learning Algorithms in Complex Stochastic Environments	82
A Dynamic, Three-Dimensional, Network-Visualization Program for Integration into CyberCIEGE and Other Network-Visualization Scenarios	83
Extensible 3D (X3D) Graphics for Visualizing Marine-Mammal Reaction to Underwater Sound on the Southern California ASW Range (SOAR)	83
OPERATIONS RESEARCH	
An Integer Linear Program to Combine Container Handling and Yard-Crane Deployment	85
An Examination of the Armed Forces’ Classification Test and Its Use as a Force-Shaping Tool	85
Design of Experiment and Analysis for the Joint Dynamic Allocation of Fires and Sensors Simulation	86
Test and Evaluation of the Micro-Observer Sensor System for Use as a Seismic-Surveillance Device in an Integrated Sensor Network	86
The Total-Army Competitive Category Optimization Model: Analysis of U.S. Army Officer Accessions and Promotions	87
Modeling Insurgency Attrition and Population Influence in Irregular Warfare	87
Conflict Resolution and Optimization of Multiple-Satellite Systems	88
Exploring Naval Tactics with Unmanned Aerial Vehicles in an Island Complex Using Agent-Based Simulation	88
Historical Review of Cost Performance Index Stability	89
An Alternative Optimization Model and Robust Experimental Design for the Assignment-Scheduling Capability for Unmanned Aerial Vehicles (ASC-U) Simulation	89
Sample-Size Determination for Estimation of Sensor Detection Probabilities Based on a Test Variable	90
Analysis of Interactions of Logistics Elements of K-1 Tracked Vehicles in the Republic of Korean Army by Using Simulation Model	90
Data-mining the Army Reserve for Analysis of Attrition Factors	91
U.S. Chemical-Warfare Stockpile Vulnerability: Effects to Local Infrastructure from a Chemical-Agent Release	91
Eastern North Carolina Marine Corps Forces and Installations’ High-Intensity Hurricane Evacuation-Decision Support	92
System-of-Systems Test Planning in a Complex, Joint Environment	92

TABLE OF CONTENTS

PHYSICAL OCEANOGRAPHY

Directional Characteristics of Inner-Shelf Internal Waves.....	93
The Value of Numerical Forecast Products in Improving Tactical Air-Delivery Methods.....	93
The Consequences of Wind Forcing on Ocean Circulation Over the Continental Shelf North of the Monterey Bay.....	94

PHYSICS

Radar Target Recognition Using Bispectrum Correlation.....	95
Deployment of Shaped Charges by a Semi-Autonomous Ground Vehicle.....	95
Laguerre-Gaussian Modes in the Free-Electron Laser	96
Triggered, Infrared-Emitter Displays for Individual Identify-Friend-or-Foe and Vehicle-Mounted Identify-Friend-or-Foe Devices	96

PROGRAM MANAGEMENT

Organizational Strategic Planning and Execution: Should Governmental Organizations Rely on Strategic Planning for the Success of the Organization?	97
--	----

SYSTEMS TECHNOLOGY

Aegis Platforms: Using Knowledge-Value-Added Analysis to Assess Open Architecture in Sustaining Engineering.....	99
Joint Networking Command-and-Control Communications Among Distributed Operations, Joint Close-Air Support, and Joint Fires	99
Normative Command-and-Control Influences: A Study of Cohesion in Terrorist Organizations and Their Effect on Society.....	100
Counterterrorism Tactics: A Model of Cell Dynamics.....	100
The Impact of Television News Coverage on Al-Qaeda's Operations.....	101
A Systems Approach towards High-Energy Laser Implementation aboard Navy Ships	101
Command and Control for Distributed Operations: An Analysis of Possible Technologies, Structure, and Employment.....	102

MASTER OF ARTS

NATIONAL SECURITY AFFAIRS

The New Middle-East Security Threat: The Case of Yemen and the Gulf Cooperation Council	105
Biological Weapons Attribution: A Primer	105
Evaluating Russian Dual-Use Nuclear Exports.....	106
Private Military Firms as Instruments of U.S. Foreign Policy: The Case of Colombia	106
The Roots and Evolution of the Royal Australian Navy	106
The Prospect of China's Access to Naval Facilities in Burma and the Ramifications for Regional Stability	107
The Rise of China's Middle Class and the Prospects for Democratization.....	107
Nasser and Pan-Arabism: Explaining Egypt's Rise in Power.....	108
Égalité Ou Réalité: Where Do Muslims Truly Reside in Today's France?	108
The European Union's Policy Regarding Peace and Security in Sub-Saharan Africa Since the End of the Cold War: Concepts and Implementation.....	109
A ReRun in Turkey: A Coup in the Near Future?	109
Germania, Quo Vadis? Dynamics of Change in German Security Policy	110
Better Lucky Than Good: Operation Earnest Will as Gunboat Diplomacy	110
Taking Jihad Out of the Hands of Infidels.....	110
Heeding Cultural Prerogatives: The Evolving Politics of Wine Regulation in France	111
A Case Study in Transnational Crime: Ukraine and Modern Slavery	111
Criminals and Insurgents: The Role of Ethnicity in State Responses to Internal-Resource Competitors... ..	112
International Politics of the Reincarnation of the Dalai Lama	112
The Kantian Peace and Greek-Turkish Relations	113
Security Culture in Times of War: How Did the Balkan War Affect the Security Cultures in Germany and the United States?.....	113
NATO: From Shadow to Substance—The Formative Years, Insights for the 21st Century	114

TABLE OF CONTENTS

Mexican Migration: Assessing Root Causes	114
United States' Engagement Strategy for North Korea.....	115
Counterterrorism Policy in Colombia.....	115
The Conflict Aftermath - A Chance for Democracy: Norm Diffusion in Post-Conflict Peace Building....	115
When Islamists Turn Violent.....	116
European Security and Defense Policy: Dialectics of Autonomy.....	116
The 1974 Crisis Over Cyprus: Foreign Will or Ethnic Conflict?	117
United States–Israeli Relations: The Impact on U.S. National Interests	117
SECURITY STUDIES	
Implementation of the Abuja 11 Accord and the Post-Conflict Security of Liberia	119
Peasant Protest in Kyrgyzstan: Standing Up Next to a Mountain	119
The Pace of Peace on the Viability of Bosnia and Herzegovina, Twelve Years After Dayton	120
STUDENT INDEX	121
ADVISOR INDEX.....	125
INFORMATION FOR OBTAINING A COPY OF AN UNRESTRICTED THESIS	129

ADVANCED DEGREES

**Doctor of Philosophy
Electrical Engineer**

DOCTOR OF PHILOSOPHY

ENHANCED RADIO FREQUENCY (RF) COLLECTION WITH DISTRIBUTED WIRELESS SENSOR NETWORKS

Mickey S. Batson-Commander, United States Navy

B.S., University of Mississippi, 1988

M.S., Naval Postgraduate School, 1998

Doctor of Philosophy in Electrical Engineering-June 2007

Advisor: John C. McEachen, Department of Electrical and Computer Engineering

In this research, a novel approach for conducting signals intelligence from a distributed network of wireless nodes is developed. The primary objective of this research is to enhance signal collection in a specified target direction. Two conflicting priorities are addressed. One is the time required to determine the target direction and form the beams. The other is the energy consumption involved in developing these solutions.

Two competing enhanced-collection methodologies (ECM), ECM-1, and ECM-2, are developed and analyzed. ECM-1 uses a combination of time difference of arrival (TDOA) and adaptive beam-forming. ECM-2 uses adaptive beam-forming that performs a beam scan similar to phased-array radars. Additionally, two competing methods for forming the beams are developed. Method one uses data exclusively from the same elements. Method two uses data from a new subset of sensors for each iteration. To compare the competing methodologies, analytical expressions are derived for energy consumption and development time required. ECM-1 is shown to be far superior to ECM-2 in both energy consumption and the time required to enhance signal collection, whereas method two is shown to be far superior to method one in the formation of beams.

KEYWORDS: Sensor Networks, Adaptive Beam-forming, Direction Finding, Time difference of Arrival, TDOA, Cross-Ambiguity Function, CAF

COMPUTATIONAL MODELING OF THE SPATIAL DISTRIBUTION AND TEMPORAL DECAY OF GEOMAGNETICALLY TRAPPED DEBRIS OF A HIGH-ALTITUDE NUCLEAR DETONATION

Christopher Gene Cross, Jr.-Lieutenant Colonel, United States Army

B.S., North Carolina State University, 1987

M.S., University of Washington, 1998

Doctor of Philosophy in Physics-June 2007

Advisor: Dennis Hewett, Lawrence Livermore National Laboratory

With the absence of nuclear-weapons testing there has been an increase in the reliance on simulation and modeling for the analysis of nuclear-weapons effects. The principal objective of this dissertation is to develop a particle code for modeling the spatial distribution and temporal decay of ionized fission fragments and beta-decay electrons injected into the magnetic field of the earth. No known code existed for this explicit purpose. The code provides a robust, realistic, computational capability to predict the persistent radiation environment produced for such an injection (most likely due to a nuclear detonation at high altitudes) into L-shells less than 1.5. The code can also be used to produce a source term for the weapons debris from a nuclear detonation at any high altitude location. Using the model, several of the free parameters are examined and reported to highlight the sensitivity of the persistent environment to the initial conditions fission fragment release. The parameters examined and reported here include the effects of ion release location (longitude, latitude, and altitude), the charge state of the fission fragments, the beta decay half-life, the initial pitch angle of the fission fragments, and the significance of neutral fission

DOCTOR OF PHILOSOPHY

fragments. Additionally, the effects of the magnetic bubble on the dispersion and trapping efficiency of the particles is studied and reported.

KEYWORDS: Trapped Radiation, Belt-Pumping, High Altitude Nuclear Explosion, Fission Fragments, Magnetic Bubble, Nuclear Weapons, Beta Decay

RAPID PROTOTYPING OF ROBOTIC SYSTEMS

William James Smuda-DoD Civilian

B.S., University of Illinois, 1977

M.S., Oakland University, 1988

Doctor of Philosophy in Software Engineering-June 2007

Advisor: Mikhail Auguston, Department of Computer Science

This effort describes a systems-engineering approach to the design and implementation of software for prototyping robotic systems. Developing networked robotic systems of diverse physical assets is a continuing challenge to developers. Problems often multiply when adding new hardware/software artifacts or when reconfiguring existing systems. This work describes a method to create model-based, graphical, domain-specific languages. Domain-specific languages use terms understandable to domain engineers, as well as abstract software-engineering decisions. This methodology enables domain engineers to create quality executable prototypes without being versed in the intricacies of software engineering.

Software systems, like physical systems, require explicit architectural descriptions to increase system level comprehension. Since non-software specialists do most experimental work, this effort suggests a convenient graphical, domain-specific notation to specify the prototype architecture framework. The framework specifies components using domain-specific icons. The meta-model defines constraints, connections, and available operations with components transparently to domain expert.

In this domain, the reuse of hardware/software artifacts (platforms, sensors, controls) is common. The challenge is to configure them into a prototype to examine a particular requirement. This architecture description supports multiple communication strategies between components and the tool, and automatically configures the necessary wrappers for the artifacts.

This dissertation suggests a uniform framework for a component and documentation repository. A set of rules operate on the domain model to compose software components needed to create an aggregate system. The same set of rules composes documentation for aggregate system operation. As a result, users of the prototyping environment are able to stay at a high level of abstraction and need not concern themselves with the details of the composed and generated code. Simultaneously, the prototyping environment generates appropriate information for installation and operation of all parts of the system.

KEYWORDS: Robotics, Prototyping, Component Based Software Engineering, Model-Driven Architecture, Domain-Specific Languages

ROBUST MODEL-BASED FAULT DIAGNOSIS FOR A DIRECT-CURRENT, ZONAL, ELECTRICAL-DISTRIBUTION SYSTEM

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M.S., Naval Postgraduate School, 2000

Doctor of Philosophy in Electrical Engineering-June 2007

Advisor: Roberto Cristi, Department of Electrical and Computer Engineering

A key element of the U.S. Navy's transition to an electric naval force is an integrated power system (IPS) that provides continuity of service to vital systems despite combat damage. In order to meet subsequent survivability standards under a reduced manning constraint, the IPS system must include a fault tolerant control scheme capable of achieving automated graceful degradation despite major disruptions involving cascading failures. Toward this objective, online model-based residual-generation techniques are proposed, which identify explicitly defined faults within a stochastic DC, zonal, electrical-distribution System (DC ZEDS). Two novel polynomial approaches to the design of unknown-input observers (UIO) are developed to estimate the partial state and, under certain conditions, the unknown input. These methods are shown to

DOCTOR OF PHILOSOPHY

apply to a larger class of systems compared to standard projection-based approaches where the UIO rank condition is not satisfied. It is shown that the partial-state estimate is sufficient to the computation of residuals for fault diagnosis, even in such cases where full-state estimation is not possible. In order to reduce the complexity of the system, a modular approach to fault detection and isolation (FDI) is presented. Here, the innovations generated from a bank of Kalman filters (some of them UIOs) act as a structured residual set for the stochastic DC ZEDS subsystem modules, and are shown to detect and isolate various classes of faults. Certain mathematical models are also shown to effectively identify input/output consistency of systems in explicitly defined fault conditions. Numerical simulation results are based on the well-documented Office of Naval Research control-challenge benchmark system, which represents a prototypical U.S. Navy shipboard IPS power distribution system.

KEYWORDS: Unknown Input Observers, Fault Diagnosis, Residual Generation, Power Electronics, DC Zonal Electrical Distribution System

ENERGY CONSERVATION IN WIRELESS-SENSOR NETWORKS

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M.S., Naval Postgraduate School, 1992

Doctor of Philosophy in Electrical Engineering-June 2007

Advisor: Murali Tummala, Department of Electrical and Computer Engineering

This dissertation presents a system-level approach for minimizing the power expended in achieving communication between a ground-based sensor network and an overhead unmanned, aerial vehicle (UAV). A subset of sensor nodes, termed a transmit cluster, aggregates data gathered by the network and forms a distributed antenna array, concentrating the radiated transmission into a beam aimed towards the UAV. A method is presented for more uniformly distributing the energy burden across the sensor network, specifying the time that should elapse between reassignments of the transmit cluster and the number of hops that should be placed between successive transmit clusters. The performance of two strategies for reconfiguring the communication burden between the sensor network and the UAV is analyzed in order to bring the UAV and the sensor network's beam into alignment quickly, while minimizing the energy expenditure. The optimal number of nodes that should participate in a beam-forming process in order to minimize the energy expended by the network is analyzed, and a framework to analyze the minimum energy expended in a simple beam-forming algorithm is provided. Finally, the probability that an arbitrarily selected sensor node is connected to a specified number of other nodes is analyzed, and an algorithm for the formation of near-linear arrays given random placement of nodes is presented.

KEYWORDS: Sensor Networks, Distributed Antenna Array, Energy Conservation

ELECTRICAL ENGINEER

DISTRIBUTED ALGORITHMS FOR BEAM-FORMING IN WIRELESS-SENSOR NETWORKS

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Electrical Engineer-June 2007

Master of Science in Electrical Engineering-June 2007

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John C. McEachen, Department of Electrical and Computer Engineering

Committee Members: Roberto Cristi, Department of Electrical and Computer Engineering

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Sensor nodes in a wireless-sensor network (WSN) can establish a link with an unmanned, aerial vehicle (UAV) by using beam-forming techniques to form a random array with position errors. The effect of the position errors in the array performance is examined using a MATLAB-based simulation model.

In order to spread the processing and communication load among the nodes, two new distributed algorithms for beam-forming in WSNs, based on the least-squares (LS) approximation of the desired array response, are proposed. The first is a distributed implementation of the QR decomposition. The second is an iterative method for solving the LS problem. Results indicate that the processing load is effectively shared among the nodes. In the second approach especially, the processing load can be lower than that of the centralized approach, depending on the algorithm's convergence. For both algorithms, the tradeoff for the ability to spread the processing load is the increased communication cost, which could cause an overall increase in total power consumption in the network. However, the average power per participating sensor node is still lower than that required by the cluster head in the centralized approach. Consequently, the network's susceptibility to failures due to excessive power consumption is greatly reduced.

KEYWORDS: Wireless Sensor Networks, Distributed Beam-forming, Distributed QR Decomposition, Iterative Least Squares

**MASTER
OF
BUSINESS ADMINISTRATION**

MASTER OF BUSINESS ADMINISTRATION

PRIVATE MILITARY FIRMS: HISTORICAL EVOLUTION AND INDUSTRY ANALYSIS

Yusuf Alabarda-Major, Turkish Army

Master of Business Administration-June 2007

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Master of Business Administration-June 2007

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

Cary A. Simon, Graduate School of Business and Public Policy

This study attempts to clarify and analyze the historical evolution of the private-military industry, comparing different private-military firms and their future impacts on military operations. Soldiers for hire are not a new phenomenon of the twenty-first century. They are as old as war itself. However, in the present day, soldiers for hire are part of well-organized and competently run private-military companies (PMCs). The private-military industry may be one of the most important but least understood developments in security studies to have taken place over the last decade. This new industry, where firms not only supply the goods of warfare, but also fulfill many of the professional functions, is not only significant to the defense community, but has wider ramifications for global policies and warfare.

FEASIBILITY ANALYSIS OF AN ALL-VOLUNTEER ARMED FORCE IN TURKEY

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Master of Business Administration-June 2007

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

Cary A. Simon, Graduate School of Business and Public Policy

The military foundation of the Turkish Republic has consisted of forces raised by conscription based on citizens' obligation to serve. For the most part, this has worked very well for both the Turkish armed forces and the Turkish people. However, conditions for Turkey have changed due to the post-Cold War national security environment, continuing economic growth, and the increasing need for high-tech weapons systems. Accordingly, this project provides a draft- versus all-volunteer-forces (AVF) analysis for the Turkish armed forces by evaluating the feasibility and desirability of an AVF for the Turkish armed forces.

Drawing upon information about the economy and national security environment and their relationship, the conscripted forces in place in Turkey are compared with all volunteer forces (as found, for example, in the United States). This project contributes to policy discussions by specifying the 21st century manpower needs of the Turkish armed forces. It also assesses methods for acquiring those manpower resources -comparing the draft versus AVF models in terms of economic and national security criteria. Hopefully, it will be useful in assisting in the implementation of the AVF concept in the Turkish armed forces—if that is what national authorities decide to do.

KEYWORDS: All Volunteer Forces, AVF, Draft

MASTER OF BUSINESS ADMINISTRATION

FEASIBILITY STUDY AND COST-BENEFIT ANALYSIS OF THIN-CLIENT, COMPUTER-SYSTEM IMPLEMENTATION ONBOARD UNITED STATES NAVY SHIPS

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Master of Business Administration-June 2007

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Master of Business Administration-June 2007

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

The purpose of this MBA project is to conduct a feasibility study and cost-benefit analysis of using thin-client computer systems instead of traditional networks onboard U.S. Navy ships. The technical capabilities of thin-client computer systems are examined to ensure that they will operate with the required shipboard software and in a shipboard environment. A cost-benefit analysis is also conducted to identify the possible cost savings to the Navy through the shipboard use of thin-client computer systems.

The results of this analysis show that thin-client computer networks are a cost-effective, long-term network solution for use aboard U.S. Navy ships. Because of the incompatibility of some current shipboard software and software systems with thin-clients, a thin-client network including a small number of personal-computer workstations may be required until the software is made compatible.

KEYWORDS: Thin-Client, Network Centric Computing, Shipboard

NAVY CAREER-SEA PAY: IS IT STILL A VIABLE COMPENSATING WAGE PROGRAM? A HISTORICAL AND FINANCIAL ANALYSIS

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Master of Business Administration-June 2007

Antonio L. Scinicariello-Lieutenant, United States Navy

Master of Business Administration-June 2007

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Master of Business Administration-June 2007

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

Resources should be allocated to those programs that provide benefits greater than their costs. This project examines whether the Navy's career-sea-pay program is effective at meeting that criteria for its enlisted component. Using five representative ratings, an historical review of changing trends in the Navy's use of sea pay is conducted to determine the program's intent. Cost data and measures of satisfaction with the amount of pay, including survey responses and sea duty generation amounts, are compared and analyzed. Empirical evidence suggests that the increase in career sea pay rates in fiscal year 2002 generated an increase in the willingness to go to sea; however, the increase was short-lived due to the loss in the real value of the compensation due to inflation. Additionally, statistical analysis provides no consistent verification of the relationship between the cost and intended benefit of career-sea pay, and is unable to determine sailors' assessment of the cost of sea duty. Two alternatives are proposed to improve the effectiveness of career-sea pay as an incentive to willingly perform sea duty.

KEYWORDS: Career Sea Pay, Career Sea Pay Premium, Compensating Wage Differentials, Sea-Shore Rotation

MASTER OF BUSINESS ADMINISTRATION

TEAM FORMATION UNDER NORMAL-VERSUS CRISIS SITUATIONS: LEADERS' ASSESSMENTS OF TASK REQUIREMENTS AND SELECTION OF TEAM MEMBERS

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Master of Business Administration-June 2007

Zoi Mitsopoulou-Lieutenant Junior Grade, Hellenic Navy

Master of Business Administration-June 2007

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

Cary A. Simon, Graduate School of Business and Public Policy

The blend of skills, attributes, and relationships among team members influences their mutual performance. This project addresses team composition requirements for tasks that vary in uncertainty, risk, and time pressure. Military leaders were asked to identify necessary team member attributes for strategy, negotiating, and crisis-response teams, and to compose potential teams from among their colleagues for each scenario. Their responses are combined with measures of relationships among potential teammates. Results indicate that team-selection criteria change when organizational environmental factors change, and team leaders make selection decisions considering friendship, professional ties with, and reliability of candidate team members. Motivation, professional capabilities, and leadership skills are the most preferred selection variables when the organizational situation is perceived as a crisis.

KEYWORDS: Team Formation, Team Member Selection, Leadership, Skills, Attributes, Task Assignment, Crisis Situation

APPLYING FINANCIAL PORTFOLIO ANALYSIS TO GOVERNMENT PROGRAM PORTFOLIOS

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Master of Business Administration-June 2007

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

Government agencies, the Department of Defense in particular, require decision-support tools when making funding decisions regarding portfolios of programs or projects. Government agencies have had some success in applying project portfolio management (PPM) when choosing among potential programs; however, once programs are underway, financial managers routinely face funding optimization decisions similar to those of private-sector, stock-market portfolio managers. While private-sector portfolio managers rely on "stock-price" based financial portfolio analysis to aid decision making, government financial managers lack an equivalent "stock-price" metric for program or project performance. This research suggests that the government's earned-value management system (EVMS) metrics may be used to generate a suitable proxy with which financial portfolio analysis can be conducted. From this analysis, risk and return trade-offs can be quantified and used when making portfolio decisions. An example using representative EVM data is presented. Recommendations on the possible applicability and limitations of the technique are discussed.

KEYWORDS: Portfolio Analysis, Financial Management, Earned Value Management, Federal Government, Modern Portfolio Theory

MASTER OF BUSINESS ADMINISTRATION

THE REMAKING OF AN AMERICAN ICON: A NAVAL-POSTGRADUATE-SCHOOL GRADUATE CASE COMPETITION

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Master of Business Administration-June 2007

Joseph M. Margolies-Major, United States Army

Master of Business Administration-June 2007

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Master of Business Administration-June 2007

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Master of Business Administration-June 2007

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The purpose of this MBA project is to provide a creative marketing overview of ideas for launching the 2008 Cadillac CTS Sedan into a non-traditional target market, e.g., perpetual strivers and move-ups. The project includes a national case competition among business-school student teams, including compressing a communications plan into a thirty-slide deliverable. Data collection includes comparison literature reviews, male and female focus groups, a researchers-developed survey, and interviews conducted during the Detroit Auto Show.

The study team creates a new logo for the CTS, including the new tagline (Revive the Drive). Given the boundaries of a \$30M media budget, the team designs a media and communications plan encompassing both traditional and nontraditional methods. Additional findings include: 1) the automotive press is biased against American manufacturers, which translates into consumer bias; 2) the wheels on the CTS are a prime example of past mistakes that Cadillac is apparently not willing to recognize; 3) it will be difficult to break the current brand persona as an older person's car without radically changing the surroundings in both sales outlets and promotional advertising; and 4) simply stated, likely buyers are not classifying the CTS with other similar models from alternative companies.

KEYWORDS: Cadillac, Marketing, EdVenture Partners, CTS, Positioning, Surveys, Re-Branding, Communications Plan, Distribution, Dealership, Image, Association

DEVELOPING AN ACQUISITION STRATEGY FOR THE COLOMBIAN NAVY'S NEW STRATEGIC SURFACE SHIPS

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Master of Business Administration-June 2007

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

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

The Colombian navy is a modern, disciplined, and well-trained military service performing a constitutional mission to defend the integrity of the Colombian maritime territory and enforce government policies concerning use of the sea. Today, the strategic fleet fulfilling these duties faces normal aging problems that threaten the execution of the Colombian navy's mission in the near future. The country's fiscal situation is tight and no funds are budgeted to support a contract acquiring new ships. The Colombian navy will need to replace its strategic surface ships in order to upgrade its tactical capabilities to new technology. The most viable option is the acquisition of second-hand ships available on the international market. The U.S. defense acquisition system has been in place for almost sixty years and has proven its efficiency by providing defense systems to the U.S. military services; therefore, after conducting a comprehensive literature search and bibliographic review, the U.S. DoD acquisition strategy was the model selected for a proposed acquisition strategy suitable for the Colombian navy's unique conditions. The resulting product, recommendations, concerns, and areas of further research coincide with the need to develop a flexible and reliable acquisition system to face the future of progress within the Colombian navy.

KEYWORDS: Acquisition Management, Acquisition Planning, Acquisition Strategy, Colombian Navy, Acquisitions, Strategic Ships

MASTER OF BUSINESS ADMINISTRATION

**A GAME-THEORY VIEW OF THE RELATIONSHIP
BETWEEN THE U.S., CHINA, AND TAIWAN
Chin-Hao Chang-Captain, Republic of China Army
Master of Business Administration-June 2007**

**Advisors: Raymond E. Franck, Graduate School of Business and Public Policy
Francois Melese, Defense Resources Management Institute**

The Taiwan Strait issue has been a major concern for those interested in the foreign policy of the United States. For quite some time, the peaceful solution to the Taiwan Strait issue has been a joint objective of the U.S., China, and Taiwan. In 1962, the Cuban Missile Crisis between the Soviet Union and the U.S. almost brought about a destructive nuclear war. However, the U.S. applied a brinkmanship strategy that ended the crisis peacefully. Brinkmanship is one of the more interesting applications of game theory. Game theory is applied and possible results of a brinkmanship strategy in the context of the present Taiwan Strait situation are analyzed. Both this idea and other examples are used to illustrate how game theory might be applied to understand the Taiwan Strait issue.

KEYWORDS: Game Theory, Brinkmanship, Stag Hunt, Taiwan Strait Issue, Cuban Missile Crisis

**ESTIMATING THE TOTAL COST OF A PERSONNEL SECURITY CLEARANCE
Maurice G. Cullen-Major, United States Air Force
Master of Business Administration-June 2007**

**Advisors: Joseph G. San Miguel, Graduate School Business and Public Policy
Howard Timm, Defense Personnel Security Research Center**

The purpose of this MBA project is to identify, classify, and summarize elements of the total cost of human, physical, and financial resources used in the personnel security system. This project is conducted at the request of the Defense Personnel Security Research Center. Costs associated with the personnel security clearance system are estimated, and areas for potential cost avoidance are identified. Activity-based costing is used to help identify time-related costs that are often unclear and unbudgeted under the current process. The findings indicate that time-related costs are several times higher than fees charged per investigation.

KEYWORDS: Personnel Security, Cost Avoidance, Activity-Based Costing

**“HELIOS DYNAMICS:” A POTENTIAL FUTURE POWER SOURCE FOR THE
GREEK ISLANDS**

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Master of Business Administration-June 2007
Ioannis Angelis-Major, Hellenic Air Force
Master of Business Administration-June 2007**

**Advisors: Ron Tudor, DoD Contractor
Jeffrey R. Cuskey, Graduate School of Business and Public Policy**

The use of alternative renewable energy sources is becoming an increasing possibility to satisfy the energy demands of the future. Environmental concerns and economic benefits, but most of all, the potential exhaustion of current sources of energy such as fossil fuels have alarmed the international community and served as incentives for the promotion of other energy forms. In this demanding environment, photovoltaics (PV) stand as a promising solution for the electrification of a large portion of the population. Particularly in the case of the off grid sites, such as the Greek islands, this solution promises to end the reliance on the costly and environmentally harmful use of oil as the only means of energy production.

The objectives of this project are: 1) to examine the country's energy policies and legal environment as they relate to energy production and delivery to off grid islands, 2) to provide a cost-benefit analysis of shifting to PV energy, and 3) to build a preliminary body of knowledge to facilitate future research involving the development of new PV technologies in remote locations.

Researchers estimate that this study will help the cause of broadening the use of renewable energy sources.

MASTER OF BUSINESS ADMINISTRATION

KEYWORDS: Off Grid Islands, Renewable Energy Sources, Photovoltaics, Diesel-Driven Generators, Legislation, Atira Technology

APPLICABILITY ANALYSIS OF PERFORMANCE BASED LOGISTICS IMPLEMENTATION FOR THE U.S. ARMY STRYKER ARMORED VEHICLE TO IMPROVE TURKISH ARMY WEAPON SYSTEM SUPPORT

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Master of Business Administration-June 2007

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This research examines the total life cycle logistics system and performance based logistics (PBL) implementation. This report looks into the application of Defense Acquisition University's 12-step PBL implementation model, defined in *Performance Based Logistics: A Program Manager's Product Support Guide* (March 2005) for Stryker light-armored-vehicle support. The research consists of a literature review of total-lifecycle system management, supply-chain management concepts, and performance-based logistics. It is followed by a comparative analysis of PBL application between the Stryker light-armored-vehicle program and the Turkish army's advanced, armored, combat-vehicle program-support practices. This research provides recommendations for improving the Turkish army's weapons-system support and maintainability based on findings, and introduces potentials through implementation of PBL practices for the Turkish army.

KEYWORDS: Performance Based Logistics, Performance Based Contracting, Performance Based Acquisition, Maintenance and Support, Supply Chain Management, Life Cycle Logistics, Total Life Cycle System Management, Stryker Armored Vehicle, Turkish Army, Turkish Advanced Armored Combat Vehicle, Stryker Brigade Combat Team

STUDY OF THE HELLENIC MILITARY'S EDUCATION-BUYING PROCESS USING TREND ANALYSIS TO IDENTIFY DETERMINANT FACTORS

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Master of Business Administration-June 2007

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Master of Business Administration-June 2007

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International students are an important part of the student population at the Naval Postgraduate School and Greece is one of the major countries sending students to NPS. As an important contributor to the NPS student population, a better understanding of the situation, trends, and opportunities is of great value to the NPS administration.

The objectives of this project are to 1) describe the current situation concerning international-student participation at NPS, 2) identify the top three countries with the highest participation through the last four years, and 3) determine the decision-making process of the Hellenic military's "buying center" for education, and factors affecting this process.

The starting point of this project is to analyze attendance records of international students to identify the top three countries with the largest population of students at NPS. Then, the study concentrates on analyzing the behavior of the Hellenic military's "buying center" for education, using trend analysis to determine the factors that are driving its decision making.

KEYWORDS: Naval Postgraduate School, International Student Population, Hellenic Military Buying Center for Education, Deciders, Approvers, Influencers, Buyers, Trends

MASTER OF BUSINESS ADMINISTRATION

WORLDWIDE HUSBANDING-PROCESS IMPROVEMENT: COMPARATIVE ANALYSIS OF CONTRACTING METHODOLOGIES

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Ronaldo Manalang-Lieutenant Commander, United States Navy

Master of Business Administration-June 2007

Paul Metzger-Lieutenant, United States Navy

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Advisors: Cary A. Simon, Graduate School of Business and Public Policy

Aruna Apte, Graduate School of Business and Public Policy

This study is designed to support one of three major focus areas in the Naval Supply Systems Command (NAVSUP)'s Worldwide Husbanding-Improvement Process initiative. Existing contracting methodologies are analyzed using the following methods: characteristics of existing contract vehicles within forecasting and simulation frameworks; strengths, weaknesses, opportunities, and threats (SWOT) analysis, and stakeholder analysis. Conclusions are drawn and recommendations outlined for optimum methods of contracting for husbanding services as requested by the Worldwide Husbanding-Process Improvement action team. Historical husbanding contract data are reviewed, including constraints and desired performance criteria. Implementation of a flat-rate, low-variability, well defined, and constant set of requirements minimizes risk and price fluctuations. Conversely, adoption of a cost-reimbursable contract type is both undesirable and infeasible. A contracting methodology that represents a best-value tradeoff within constraints should be flexible and risk-based while offering performance-based incentives.

THE IMPACT OF DECLINING DEFENSE BUDGETS ON THE JAPANESE MARITIME SELF-DEFENSE FORCE

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Master of Business Administration-June 2007

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

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

The purpose of this thesis is to analyze the impact of declining defense budgets on the Japanese Maritime Self-Defense Force (JMSDF). Because of the huge debt of the government of Japan and financial structural reform, the Japan is trying to reduce all expenditures, including defense expenditures.

Conversely, Japan and countries in its vicinity face the threat of uncertainty. China is increasing its defense budget to build a modern oceanic navy. North Korea recently conducted a nuclear test in defiance of the international community.

Therefore, it is a big challenge for the JMSDF to sustain and develop its capabilities under the pressure of the budget and the national-security environment.

KEYWORDS: Japan, Navy, Maritime Self Defense Force, Budget, Defense Budget, Shipbuilding, Continued Expense

MASTER OF BUSINESS ADMINISTRATION

BUDGET SCORING OF ALTERNATIVE FINANCING METHODS FOR DEFENSE REQUIREMENTS

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This research investigates procurement scoring and the Department of Defense's use of alternative financing methods, such as leases and public/private ventures. One of the major impediments to using alternative forms of procurement financing for acquiring defense capabilities is in the budgetary treatment, or "scoring," of these initiatives by the Congressional Budget Office, the Office of Management and Budget (OMB), and the Congressional budget committees. The current scoring policy that has been applied to many initiatives essentially negates the financial advantage of using alternative forms of financing. Therefore, this research examines existing policies and their adherence to statutes, and the role of the various government organizations and committees in actual recording of obligations and outlays related to financing alternatives used by federal agencies. Preliminary evidence suggests that this emerging area has major importance for future DoD acquisitions in a resource-constrained environment. Included are recommendations for changes in budgetary scoring that encompass the full scope of federal obligations and expenditures, while promoting efficient and more rapid and fiscally responsible acquisitions.

KEYWORDS: Alternative Financing, Leasing, Public-Private Partnership, Government Budget, Budget Crisis, Acquisitions, Federal Budget, ESPC, Scoring, CBO, OMB, House/Senate Budget Committees, Fort Hood Family Housing, LLP, Chicago Westside Regional Headquarters

AN ANALYSIS OF THE JOINT MODULAR, INTERMODAL, DISTRIBUTION SYSTEM

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**Brian Luebbert-Lieutenant, United States Navy
Master of Business Administration-June 2007**

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The joint modular, intermodal, distribution system (JMIDS) is a joint-capability, technology demonstration (JCTD) initiative approved by the deputy undersecretary of defense for advanced systems and concepts. The purpose of JCTD is to evaluate joint capability through military-utility assessments (MUA) under a variety of military scenarios, while JMIDS aims to address interoperability problems facing the military supply chain. The operational concept of JMIDS is to provide a universal, intermodal container system for automated handling, storage, and tracking of supply and ammunition shipments throughout the four services in order to enhance visibility and increase efficiency in the supply chain. This joint modular, intermodal capability is achieved through the use of joint modular, intermodal containers (JMIC), joint modular, intermodal platforms (JMIP), and automated identification technology (AIT). Through the use of these three systems, JMIDS permits the efficient and seamless movement of supplies and retrograde operations through air, land, and sea distribution to all military locales. The purpose of this thesis is to analyze the costs and benefits of implementing the JMIDS capability within the defense distribution system (DDS).

KEYWORDS: Joint Modular Intermodal Distribution System, Radio Frequency Identification, Modularity, Automated Information Technology

MASTER OF BUSINESS ADMINISTRATION

COST IN HIGHER EDUCATION

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

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

The objective of this research is to look into the cost structure used by two institutions of higher education: the Naval Postgraduate School and California State University, Monterey Bay. The financial data that determines the consistency of the cost metrics in the decision making of these institutions is considered. An analysis of the cost information used to make and support decisions is presented. The variety of the cost structures within the researched institutions is analyzed and compared to identify the factors that generate the differences of the cost structures.

KEYWORDS: Costs, Cost Structure, Instructional Cost, Unified Across Schools Cost, Disciplinary Mix

THE DETERMINATION OF NURSING-MANPOWER REQUIREMENTS IN HUMANITARIAN-ASSISTANCE MISSIONS FOR HOSPITAL SHIPS

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Master of Business Administration-June 2007

Advisors: Anke Richter, Defense Resources Management Institute

Paula Konoske, California State University, San Diego

The purpose of this thesis is to determine the nursing-manpower requirements for humanitarian and civic-assistance missions performed by Navy hospital ships. The qualitative analysis component of this thesis includes a comprehensive literature review performed on doctrines, guidances, past humanitarian-mission studies, and nurse-staffing models. In contrast, the quantitative analysis component includes an ordinary least-squares regression analysis to estimate patient length of stay. Various model constructions are reviewed, utilizing different patient controls and indicators in an effort to identify a reasonable estimation approach and to validate the integrity of the available empirical data from the USNS *Mercy* deployment in 2006. Furthermore, a Chi-square test is conducted to review the statistical significance between the observed patient ICD-9 classification frequencies in an effort to better understand the types of capabilities that a future mission should expect to provide. The results of these analyses are applied in the development of an estimation calculator to define shipboard inpatient nursing manpower requirements. Suggestions are provided for areas of future research, which will provide insight regarding additional staffing requirements in other areas, such as medical civic-action programs, which is necessary for developing a more robust calculator.

KEYWORDS: Manpower Requirements, Hospital Ships, Humanitarian Assistance, Nursing

FOREIGN MILITARY SALES-TREND ANALYSIS: IMPACTS ON THE FUTURE WITH APPLICATION TO TAIWAN

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This MBA project investigates and provides an analysis of the prominent factors that affect the United States's foreign-military sales (FMS) program. This project is conducted with the sponsorship and assistance of the Naval Postgraduate School's Acquisition Research Institute and financial-management

MASTER OF BUSINESS ADMINISTRATION

and international programs. The overall goal of this project is threefold: 1) to identify the purpose of the FMS program and its processes; 2) to identify, define, and evaluate historical economic, political, social, and industrial changes and trends that affect FMS worldwide allocation and support; and 3) to apply these findings to a specific country (Taiwan) to predict future participation and support.

The role of arms sales in world politics has grown tremendously since World War II, and more specifically since the passage of new arms laws in 1979. The importance of FMS is increasingly evident in the foreign policies of both supplier and recipient nations, in international politics, competition, and relations. In recent years, arms sales have become a crucial dimension of international affairs. This paper examines several trends in military equipment, services, and training exchanges, and evaluates their potential impact on the conduct of conflict in the future. The nature of FMS is complex. This research identifies and analyzes trends relating to sociopolitical, economic, and industrial and technological changes as associated with FMS spending. These findings are applied to Taiwan as a case study and the customer's experience with FMS is expanded upon. The intent of this paper is to increase the reader's knowledge of FMS, pinpoint trends, and use FMS to Taiwan as a point of comparison to better appreciate this extremely complex and not well understood program.

KEYWORDS: Foreign Military Sales, Direct Commercial Sales, Security Assistance, Taiwan Foreign Military Sales

AN ANALYSIS OF MANPOWER REQUIREMENTS FOR THE UNITED STATES MARINE CORPS' TIERS II AND III UNMANNED-AERIAL-SYSTEMS PROGRAM

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This research is conducted to examine the quantitative and qualitative component requirements for Tier II and Tier III of the United States Marine Corps' unmanned-aerial-systems program. The main objective of this research is to develop a proposed manpower structure for a composite squadron in order to improve current UAS capabilities while minimizing manpower requirements.

This is accomplished by conducting an independent assessment of manpower requirements of the different strategies being considered under the unmanned, aerial systems' family of systems (UAS FoS) for the Marine Corps for Tiers II and III.

The author recommends consolidation of Tiers II and III to form a composite UAV squadron, reduce the logistics footprint by relegating the support mission to the MWSS and the MALS, and combining operational and maintenance billets within the current VMU structure to consolidate manpower requirements and optimize UAS force structures.

KEYWORDS: Manpower, Manning, Personnel, Requirements, Unmanned Aerial Vehicles, UAV, Unmanned Aerial Systems, UAS, RQ-2 Pioneer, ScanEagle, Dragon Eye, Shadow 200, RQ-11 Raven B, Knowledge, Skills and Abilities, KSA, Training

USING AN EXPERIMENTAL APPROACH TO IMPROVING THE SELECTIVE REENLISTMENT-BONUS PROGRAM

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The selective reenlistment-bonus program is a powerful force-management tool to increase retention in undermanned skills. This thesis analyzes many of the theoretical applications of alternative compensation methods, specifically auctions, signaling theory, and experimental economics; and explains how an economic experiment might be applied within the Department of Defense. This experimental approach

MASTER OF BUSINESS ADMINISTRATION

presents service members with a certain scenario that mirrors a choice they might face when posed with a retention decision. Economic experiments are an inexpensive way to make more informed personnel-policy decisions. This thesis postulates that economic experiments are an excellent means to capture the human element in decision making. Additionally, economic experiments provide another form of simulation to “wind-tunnel”-test policy changes before implementing them across the services. The sample experiment discussed in this thesis combines the theoretical principles of both auction and signaling theory, and provides a means to analyze concrete data, which the Department of Defense could use before actually conducting an auction of selective reenlistment bonuses.

KEYWORDS: Bonuses, Auctions, Auction Theory, Signaling, Signaling Theory, Job Market, Retention, Experimental Economics

THE NATURE OF DEPARTMENT-OF-DEFENSE REPROGRAMMING

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Over the years, plenty of attention has been paid to how much the Department of Defense spends annually in the form of reports and studies. However, very little attention has been given to the area of reprogramming. This paper seeks to answer one main question: what is the nature of DoD reprogramming? In answering this question, a specific methodology for describing reprogramming information is developed. The benefits of this study are to highlight the use of reprogramming and to provide a baseline of knowledge about an area of research where previously there was none. This study finds that the amount of reprogramming increased over sixty percent over the eight years studied. While the total amount reprogrammed increased, reprogramming as a percentage of total budget authority remained relatively constant. The majority of the increase came from an increase in prior-approval reprogramming actions. In general, there is very little congressional resistance to reprogramming requests and there are definite patterns as to when reprogramming was done throughout the year. Finally, this paper provides specific recommendations for areas of future research.

KEYWORDS: Reprogramming, Budget Execution, Department of Defense

A STATISTICAL ANALYSIS OF LOS-ANGELES CLASS OPERATING/OPERATIONAL-TARGET EXPENDITURES AMONG PACIFIC-FLEET HOMEPORTS

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

For the past several years, average operating/operational-target (OPTAR) expenditures for Los Angeles class submarines have differed among their three homeports in the Pacific Ocean. To justify expenditures or find efficiencies, three statistical analyses are performed to verify these differences.

OPTAR data are cross-referenced with expenditure information from the Naval Center for Cost Analysis's database for visibility and management of operating and support costs (VAMOSOC). The database produced the data set, which consisted of samples from three OPTAR populations: total OPTAR, repair OPTAR, and other OPTAR. These population samples are analyzed using the student-t test, the Wilcoxon rank-sum test, and regression with panel data. The main analysis compares the samples from different ports. A follow-on analysis is completed using schedule data as an input.

Statistically significant differences are discovered between homeports within the other OPTAR population. In the follow on analysis, using regression with panel data, correlations are found between OPTAR expenditures and ship schedules.

KEYWORDS: Navy, Submarines, Operating Target, OPTAR, Statistic, Cost Analysis, Cost Estimation, Operating and Support

MASTER OF BUSINESS ADMINISTRATION

CROSSING THE TECHNOLOGY-ADOPTION CHASM IN THE PRESENCE OF NETWORK EXTERNALITIES: IMPLICATIONS FOR THE DEPARTMENT OF DEFENSE

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This thesis explores factors inhibiting technologies from crossing the technology diffusion “chasm” between early and wide-scale adoption. It focuses on cost and benefit uncertainty, as well as network effects applied to end users and their organizations. Specifically, it explores DoD acquisition programs bringing promising technologies to the field; defines successful technology adoption as realizing its full potential return on investment by achieving the widest potential warfighter use; draws parallels between the private and public sectors’ technology-adoption experiences; identifies recurring issues ultimately affecting end-user decisions to adopt technology; and provides a framework for economic experiments to verify that the identified issues correspond to observed technology-diffusion patterns.

Recurring issues that inhibit technology diffusion include:

- Loss of control and autonomy
- Misperceptions about broader mission and organizational pressures
- Misaligned system incentives
- Uncertainty regarding management’s commitment
- Discontinuity of a program champion
- Uncertain availability of complementary goods

Identifying, analyzing, verifying, and addressing these issues will facilitate technology transfer. If technology falls short of its diffusion potential, resources will be wasted and national security compromised; if technology reaches its potential, the warfighter will have the best available tools to do the job and the DoD will achieve maximum return on investment of valuable public resources.

KEYWORDS: Coordination, Externality, Network Externality, Technology Adoption, Chasm, Diffusion, RFID, NMCI, JCTD, ACTD, Economic Experiment, Critical Mass, Technology Adoption Life Cycle

EVALUATION OF CONTRACT MANAGEMENT PROCESSES IN THE UNITED NATIONS FOR ACQUIRING PEACEKEEPING OPERATIONS/SERVICES

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United Nations (UN) peacekeeping operations have increased significantly over the years. When a crisis develops in any part of the world, the UN is expected to respond. It examines the overall situation to assess the political and military goals, required composition of force, equipment, training, financial implications, circumstances of deployment, and effectiveness of the peacekeeping operation required. The UN does not have any permanent force structure; and is dependent on its member states for contribution of forces, though the equipment may or may not be provided by the troops contributing countries. The UN has a standard procedure for acquiring peacekeeping operations/services. The process is a contract between United Nations’ Department of Peacekeeping Operations (UNDPKO) and the troops contributing countries. Though there is a similarity between the UN-followed contract management process and the generally accepted contract management process identified in the contract management body of knowledge, there are many differences as well. The purpose of this study is to evaluate the existing UN contract management process for acquiring peacekeeping operation/services from various troops contributing countries against the generally accepted contract management process identified in the contract management body of knowledge; and to evaluate the contract management process maturity in order to assess the effectiveness of the UN contract management process for obtaining peacekeeping operations/services from troops contributing countries.

MASTER OF BUSINESS ADMINISTRATION

KEYWORDS: Acquisition, Analysis, Contract, Contract Management, Contract Management Maturity Model, Contract Management Maturity Assessment Tools, Evaluation, Force Generation Service, Maturity Level, Peacekeeping Operations, Ratings, Structure, Troops Contributing Countries, United Nations, United Nations Department of Peacekeeping Operations

A STATISTICAL ANALYSIS OF THE CAREER INTENTIONS OF MOBILIZED, ENLISTED, SELECTED RESERVISTS

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Stephen L. Mehay, Graduate School of Business and Public Policy**

This thesis examines the career intentions of mobilized Navy, enlisted, selected reservists (SELRES). A logistic-regression model is estimated to explain the effects of mobilization on reservists' intentions to stay to retirement. The statistical analysis uses data from the 2002–2004 Naval Reserve Career Decision Survey, which provides information on the demographics, reserve characteristics, and mobilization experiences of currently or recently mobilized enlisted SELRES members. Results indicate that mobilization experiences (previously mobilized, command leadership at the gaining command, assigned to an interesting job, effect on civilian job, and the difference in pay between active and active duty pay while mobilized) are significant factors influencing a mobilized SELRES member's intention to stay to retirement. However, only a few of the demographic and reserve characteristics significantly impact a SELRES member's career intentions. Recommendations for expanding data collection and for follow-on studies are provided, and implications for Navy SELRES mobilization policy are discussed.

KEYWORDS: Navy Reserve Retention, Reserve Retention, Navy Reserve Manpower, SELRES Retention, Mobilization

EVALUATION OF NAVAL AVIATION ENTERPRISE AIRSPEED'S GENERATION OF MEASURABLE COST SAVINGS AND REINVESTMENT FOR RECAPITALIZATION OF THE FUTURE NAVY AND MARINE CORPS

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Naval aviation, faced with budgetary pressures, decreasing buying power, and increasing costs of aircraft and equipment, realized it had to change the way it did business in order to recapitalize. The Naval Aviation Enterprise (NAE) was formed to implement the aviation components of Sea Power 21 and Sea Enterprise, including modernization and recapitalization. Through the implementation of AIRSpeed, the NAE strives to provide "the right amount of readiness at the right cost, so that money can be saved and returned to the Navy and Marine Corps to recapitalize the fleet."

This thesis examines the NAE's effort to generate measurable cost savings toward recapitalization. The background and implementation of AIRSpeed are reviewed. Cost savings attributed to AIRSpeed initiatives are identified, and the relationship between costs savings and reinvestment and recapitalization is investigated.

The results of this thesis reveal that the NAE is achieving measurable cost savings, but the cost savings have not been made available for recapitalization. This thesis reveals some identifiable organizational challenges and change issues that inhibit the achievement of NAE's goals. These findings are used to develop and present a series of recommendations to assist the leadership to further align AIRSpeed programs with the recapitalization vision.

KEYWORDS: Naval Aviation Enterprise, AIRSpeed, Cost Savings, Recapitalization, Continuous Process Improvement, Benefits, Flying Hour Program, Wedge, NAE, NAVRIIP, ADMS

MASTER OF SCIENCE

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

MASTER OF SCIENCE IN APPLIED MATHEMATICS

REALIZABLE TRIPLES IN DOMINATOR COLORINGS

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Given a graph G and its vertex set $V(G)$, the chromatic number, $\chi(G)$, represents the minimum number of colors required to color the vertices of G so that no two adjacent vertices have the same color. The domination number of G , $\gamma(G)$, is the minimum number of vertices in a set S , where every vertex in the set $V(G) - S$ is adjacent to a vertex in S . The dominator chromatic number of the graph, $\chi_d(G)$, represents the smallest number of colors required in a proper coloring of G with the additional property that every vertex dominates a color class. The ordered triple, (a, b, c) , is realizable if a connected graph G exists with $\gamma(G) = a$, $\chi(G) = b$, and $\chi_d(G) = c$. For every ordered triple, (a, b, c) of positive integers, if either (a) $a = 1$ and $b = c \geq 2$ or (b) $2 \leq a, b < c$ and $c \leq a + b$, previous work has shown that the triple is realizable. The bounds do not consider the case $a = b = c$. In an effort to realize all the ordered triples, graphs and graph classes with $a = b = c = k \geq 2$ are explored.

KEYWORDS: Graph Theory, Graph Coloring, Graph Domination, Dominator Chromatic Number

MASTER OF SCIENCE IN APPLIED PHYSICS

INTEGRATING THE FREE-ELECTRON LASER ON AN ALL-ELECTRIC SHIP

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This thesis examines the feasibility of placing the free-electron laser (FEL) on the all-electric ship. The power required by the FEL and the tolerance of the FEL to vibrations is determined using computer simulations. Methods for reducing vibration using isolation and active alignment are described. The simulations show that the all-electric ship will provide more than enough power to operate the FEL. The results also indicate that there must be methods to reduce the effect of ship vibrations in order for the FEL to reach the desired output power of one to three megawatts.

The thesis describes the physical dimensions of the FEL, as well as its weight, and compares these figures to other ship systems. Overall, simulations and research show that it is reasonable that a high-powered FEL can be developed for use as a weapon on the all-electric ship. While developing such a weapon will be an engineering challenge, the capability to do so has been demonstrated.

KEYWORDS: Free Electron Laser, FEL, All-Electric Ship, Directed Energy, Vibration Mitigation

A HYBRID, LARGE-SCALE, WIRELESS-SENSOR NETWORK FOR REAL-TIME ACQUISITION AND TRACKING

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This thesis proposes a hybrid, large-scale, wireless-sensor network (WSN) designed to support real-time target detection and tracking of multiple ballistic missile threats. In particular, the proposed WSN consists of terrestrial and satellite nodes. The infrared (IR) signatures presented by the target-background combination are explored and modern IR sensor technologies are examined in search of a suitable IR sensor for the proposed hybrid, large-scale WSN. A multicolor, quantum-well, infrared photodetector, step-stare, large-format focal plane array is proposed and evaluated through performance analysis.

The thesis proposes an efficient data-dissemination mechanism, as well as a suitable medium-access control (MAC) scheme for the proposed WSN, designed to meet the real-time and accuracy requirements without introducing excessive overhead and increased end-to-end time-delays. A clustering mechanism, called the "area of interest" (AOI) is introduced, which combines the "content-based" feature of the data-centric routing approach with the principles of in-network data aggregation and clustering. Simulation results verify that aggregation within the AOI improves the data throughput across the full range of network load. A contention-based MAC scheme, carrier-sense multiple access, and a contention-free approach, time-division multiple access, are examined. Performance analysis and simulation results indicate that a contention-free approach is suitable for implementation in wireless

APPLIED PHYSICS

networks associated with large propagation delays and increased offered loads. MATLAB and OPNET modeler software packages are used to simulate and evaluate the proposed schemes.

KEYWORDS: Wireless Sensor Networks, WSN, Real-Time Target Tracking, IR Sensor, Quantum Well Infrared Photodetector, QWIP, Focal Plane Array, FPA, Data Centric Routing, In-Network Data Aggregation, Clustering Mechanism, Medium Access Control, MAC, Carrier Sense Multiple Access, CSMA, Time Division Multiple Access, TDMA

TRACK-SCORE PROCESSING OF MULTIPLE, DISSIMILAR SENSORS

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In this thesis, a data-fusion problem involving a number of different types of sensors deployed in the vicinity of a ballistic-missile launch is studied. An objective of this thesis is to calculate a scoring function for each sensor track; the track file with the best (optimum) track score can then be used for guiding an interceptor to the threat within the boost phase. Seven active ground-based radars, two space-based passive infrared sensors, and two active light-detection and ranging (LIDAR) sensors are used to track the ballistic missile in the boost phase. Each space-based platform carries one passive infrared sensor and one LIDAR. For the threat scenario, an IMPULSE intercontinental-ballistic-missile model is used to create the trajectory of a generic ballistic threat. The IMPULSE model is developed by the National Air and Space Intelligence Center to provide an accurate representation of ballistic missiles. Each sensor provides a track of the missile in the boost phase by using a multiple hypotheses tracking algorithm with an extended Kalman filter. The calculation of the track scoring function is to identify the sensor with the best track file. A track score is calculated for each sensor based on the kinematics of the missile flight parameters and the signal-to-noise ratio at the sensor. By using likelihood ratios, the optimum track file of the threat can then be determined, and the corresponding track file can be transmitted to the battle manager control in order to lead the interceptor vehicle against the threat using the track file with the best score. Using the optimum track file-scoring, signal-processing techniques developed in this thesis, the best track file can be sent to the interceptor to destroy the ballistic threat. This leads to faster response management, where the threat can be destroyed inside the territory of the country that launched the threat before any countermeasures are deployed.

KEYWORDS: TERMS Ballistic Missiles, Defense Networks, IR and LIDAR Sensors, Space-Borne Sensors, Data Fusion, Likelihood Ratios

AN INVESTIGATION OF THE STATIC-FORCE BALANCE OF A MODEL RAILGUN

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In this thesis, experimental evidence is presented that refutes the existence of a reaction force on the rails (i.e., recoil) in a model electromagnetic railgun. By mechanically decoupling the power supply from the rails, and the rails from the armature, researchers are able to carefully examine the direction and magnitude of the static forces on the model gun through a wide range of applied currents. The results from this series of experiments demonstrate that the theoretical force on an armature is at least seventy times greater than any reaction force on the rails.

KEYWORDS: Electromagnetic Railgun, Railgun Recoil, Reaction Force, Eutectic

MODELING OF HIGH-FREQUENCY ACOUSTIC PROPAGATION IN SHALLOW WATER

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This research involves numerical modeling of acoustic signals through shallow-water channels. The sound is computationally modeled in a vertical plane as a dense fan of beams radiating from the transmitter location. The cross section of each two-dimensional beam is represented as a Gaussian distribution of acoustic energy. The Gaussian beam travels axially along rays governed by Snell's Law, dispersing in width as a function of travel distance. At arbitrary receiver locations in the planar sound field, the intensity of the propagated beams is integrated over time to synthesize the multi-path channel response. The influence of the ocean channel is analyzed parametrically, including sensitivity of the eigenray structure and impulse response to water properties, channel boundaries, and source/receiver geometry. Specific maritime environments examined in this study are St. Andrew Bay, Panama City, Florida, and Chesapeake Bay, Little Creek, Virginia. This research supports the possible use of high-frequency acoustics (40-70 kHz) for short-range (500 m), through-water communications. Emphasis is on communications between seabed stations.

KEYWORDS: Acoustics, Sound, Ocean, Propagation, Shallow Water, Acoustic Communications, Computational, Bellhop

MODELING AND IMPLEMENTATION OF PROPORTIONAL-INTEGRAL-DERIVATIVE CONTROL FOR AUTONOMOUS ROBOTS

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

Proportional-integral-derivative (PID) control is optimized to control the course of a small autonomous robot for military applications. A Visual Basic program is written to model the robot response to the controller and provide a method of optimization. The computer model is based on empirical data gathered through testing. Controller theory, robot mechanics, and hardware implementation are all discussed as they relate to the ability of the robot to get from one location to another along an efficient path. The controller is tuned to provide optimal direction control and the model is evaluated for accuracy. The robot completes a 170-degree pivot turn in 4.0 seconds and a 170-degree differential turn in 5.1 seconds. The time predicted by the model for the each turn is within 10% of what the robot did.

KEYWORDS: Robotics, Modeling, PID Control, Autonomous Operations, Counter IED Operations

MASTER OF SCIENCE IN APPLIED SCIENCE

BIOLOGICAL-TERRORISM PREPAREDNESS: EVALUATING THE PERFORMANCE OF THE EARLY ABERRATION REPORTING SYSTEM'S SYNDROMIC-SURVEILLANCE ALGORITHMS

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Master of Science in Applied Science (Operations Research)-June 2007

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

After the terrorist attacks of September 11, 2001, questions developed over how quickly the country could respond if a bioterrorism attack was to occur. "Syndromic surveillance" systems are a relatively new concept that is being implemented and used by public-health practitioners to attempt to detect a bioterrorism attack earlier than would be possible using conventional biosurveillance methods. The idea behind syndromic surveillance is to detect a bioterrorist attack by monitoring potential leading indicators of an outbreak, such as absenteeism from work or school, over-the-counter drug sales, or emergency-room counts. The Center for Disease Control and Prevention's early aberration-reporting system (EARS) is one syndromic surveillance system currently in operation around the United States.

This thesis compares the performance of three syndromic-surveillance-detection algorithms, C1, C2, and C3, that are implemented in EARS, versus the cumulative sum (CUSUM) applied to model-based prediction errors. The CUSUM performs significantly better than EARS' methods across all scenarios evaluated. These scenarios consist of various combinations of large and small background-disease-incidence rates, seasonal cycles from large to small (as well as no cycle), daily effects, and various levels of random daily variation. These results lead to the recommendation to replace the C1, C2, and C3 methods in syndromic-surveillance systems with an appropriately implemented CUSUM method.

KEYWORDS: Syndromic Surveillance, Biosurveillance, Bioterrorism, Public Health, Early Event Detection, C1, C2, C3, Cumulative Sum, CUSUM

ANALYSIS OF JUNIOR RESERVE OFFICER TRAINING CORPS' PARTICIPATION AND EFFECTS ON FIRST-TERM ATTRITION, PROMOTION, AND REENLISTMENT

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This study investigates whether participation in the Junior Reserve Officer Training Corps (JROTC) significantly affects U.S. Navy's enlisted first-term attrition, promotion, reenlistment, time to attrition, and time to promotion. The first term of enlistment is defined as the first four years of naval service upon

accession (recruitment), which are mandatory by contract. This analysis takes data from the Defense Manpower Data Center's enlisted-personnel, service-member files of U.S. Navy recruits from fiscal year 1994–2000. Each recruit has seven years' worth of data for each accession year except those from 2000, who have six. This analysis finds that JROTC has a suggestive, but not definite, statistical positive association with first-term attrition and time to promotion. Furthermore, JROTC has a statistically significant positive association with promotion, reenlistment, and time to attrition. Up to this point, there has been little research on the relationship between JROTC participation and propensity to succeed in enlisted naval service. This effort, coupled with LT Roy Lamont's thesis on the effects of JROTC (March 2007), could yield significant benefit in determining the return on investment of the program from a retention and performance perspective.

KEYWORDS: JROTC, Attrition, Promotion, Reenlistment, Linear Regression, Logistic Regression, Data Analysis, Statistics, Operations Research, S-Plus

A COMPARATIVE ANALYSIS OF MULTIVARIATE STATISTICAL DETECTION METHODS APPLIED TO SYNDROMIC SURVEILLANCE

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Biological terrorism is a threat to the security and wellbeing of the United States. It is critical to detect attacks in a timely manner, to provide sufficient and effective responses that minimize or contain damage. Syndromic surveillance is the process of monitoring public-health-related data and applying statistical tests to determine the potential presence of a disease outbreak in the observed system.

This research involves a comparative analysis of two multivariate statistical methods, the multivariate CUSUM (MCUSUM) and the multivariate exponentially weighted moving average (MEWMA), both modified to look only for increases in disease incidence. While neither of these methods is currently in use in a biosurveillance system, they are among the most promising multivariate methods for this application.

The analysis is based on a series of simulations using synthetic syndromic-surveillance data that mimics various types of background disease incidence and outbreaks. It is found that, similar to results for the univariate CUSUM and EWMA, the directionally sensitive MCUSUM and MEWMA perform very similarly.

KEYWORDS: Biosurveillance, Multivariate CUSUM, Multivariate EWMA, Statistical Process Control, Syndromic Surveillance

A CONCEPTUAL FRAMEWORK FOR THE U.S. ARMY'S TACTICAL-WHEELED-VEHICLE OPTIMIZATION MODEL

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**Gordon R. McDonald-Ensign, United States Navy
B.S., United States Naval Academy, 2006**

Master of Science in Applied Science (Operations Research)-June 2007

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This thesis addresses the problem of optimizing the U.S. Army's light, tactical-wheeled-vehicle (LTWV) fleet over the next 15 years. To achieve these ends, a multiple-objective decision-analysis (MODA) model

is created; the model assigns a value to each vehicle in the LTWV fleet, as well as a linear program (LP) that allows decision makers to find feasible modernization strategies for the LTWV fleet, subject to multiple constraints such as budget and operational readiness.

The MODA assigns a value to every individual vehicle variant, depending upon its measures of performance in several categories. Those values are used by the LTWV LP to prescribe solutions for decision makers. The LTWV LP is implemented using notional data and initial analyses are run to demonstrate the program's validity. Possible analyses include varying any of the LTWV LP inputs, such as operational, budgetary, and age requirements, as well as procurement availability bounds. The project serves as a conceptual framework for future refinement of the decision tool requested by the U.S. Tank-Automotive and Armaments Command.

KEYWORDS: HMMWV, JLTV, TWV, LTWV, Multiple Objective Decision Analysis, Value Model, Linear Program, Optimization

**OPTIMAL, RANDOMIZED, SURVEILLANCE PATTERNS TO DETECT INTRUDERS
APPROACHING A MILITARY INSTALLATION**

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This thesis addresses a two-person zero-sum game between an intruder and the defender of a military installation. The intruder attempts to penetrate the installation by choosing one of many entry points, each monitored by a surveillance camera and requiring a different amount of time to transit. Although the real-time video of each surveillance camera is fed to a surveillance room simultaneously, the defender has only one surveillance monitor and can monitor only one entry point at a time. A discrete-time model is considered, such that the intruder will be detected if, during his travel time, the defender spends one time unit monitoring the entry point chosen by the intruder. The problem facing the defender is how to switch among entry points to monitor from one time unit to the next, in order to maximize the detection probability of the intruder. The intruder's goal is, of course, to infiltrate without being detected, and so he wishes to minimize this probability.

The problem is formulated as a two-person zero-sum game, and a linear program is developed to solve it. Numerical experiments provide insights into the design of such surveillance systems.

KEYWORDS: Search and Detection, Border Patrol, Camera Surveillance

MASTER OF SCIENCE IN COMPUTER SCIENCE

AN OSKIT-BASED IMPLEMENTATION OF LEAST-PRIVILEGE, SEPARATION-KERNEL MEMORY PARTITIONING

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In an environment with valuable information assets, the threat of subversion is real. Thus, systems must be built from the ground up to counter the level of sophistication and capital pitted against them. To build such systems, rigorous assurance criteria must be met.

Currently, there is no publicly available example of the design and construction of high assurance systems. The trusted-computing exemplar (TCX) project is intended to make a high-assurance component and its evaluation evidence publicly available. This work builds a working prototype of selected TCX kernel functionality.

The prototype is constructed and based on OSKit, and restricts information flow between memory partitions and resource accesses made by processes. Pages are statically allocated on a per-partition basis and page faults are handled by the kernel.

The prototype demonstrates a least-privilege-based approach to exported resource management. It uses a separation kernel with preloaded configuration data to allocate memory resources to processes.

KEYWORDS: Separation Kernel, Least Privilege, High Assurance, Paging, OSKit

TESTING AUTOMATION TOOLS FOR SECURE SOFTWARE DEVELOPMENT

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Software testing is a crucial step in the development of any software system, large or small. Testing can reveal the presence of logical errors and other flaws in the code that could cripple a system's effectiveness. Many flaws common in software today can also be exploited to breach the security of the system on which the software is running. These flaws can be subtle and difficult to find. Frequently it takes a combination of multiple events to bring them out. Traditional testing techniques focus on dealing with errors as they arise during normal operation of the system. This technique is not particularly effective. Thus, recent research has focused on developing new, more effective, software-testing techniques. Two such techniques are combinatorial testing and fuzz testing.

This thesis explores the effectiveness of combining combinatorial and fuzz testing into a single software-testing tool to aid in the discovery of subtle system flaws. The testing-automation tools developed in the course of this research will aid in the development of secure software and bolster the ranks of testing techniques available to future developers.

KEYWORDS: Software Testing, Fuzzing, Combinatorial Testing

COMPUTER SCIENCE

COUNTERINTELLIGENCE THROUGH MALICIOUS-CODE ANALYSIS

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As computer-network technology continues to grow, so does reliance on this technology for everyday business functionality. To appeal to customers and employees alike, businesses are seeking an increased online presence, and to increase productivity, computerizing their day-to-day operations. The combination of a publicly accessible interface to businesses's networks and the increase in the intellectual property present on these networks presents serious risks. All this intellectual property now faces constant attacks from a wide variety of malicious software intended to uncover company and government secrets.

Every year, billions of dollars are invested in preventing and recovering from the introduction of malicious code into a system. However, there is little research on leveraging these attacks for counterintelligence opportunities. With the ever-increasing number of vulnerable computers on the Internet, the task of attributing these attacks to an organization or a single person is daunting. This thesis demonstrates the idea of intentionally running a piece of malicious code in a secure environment to gain counterintelligence on an attacker.

KEYWORDS: Malware Analysis, Reverse Engineering, Rootkit Development, Counter Intelligence

ALLOY EXPERIMENTS FOR A LEAST-PRIVILEGE SEPARATION KERNEL

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A least-privilege separation kernel (LPSK) is part of a long-term project known as the trusted-computing exemplar (TCX). A major objective of the TCX is the creation of an open framework for high-assurance development. A relatively new specification tool called "Alloy" has shown potential for high assurance development. Researchers implement the formal security-policy model and the formal top-level specification of the TCX LPSK in Alloy, and conclude that Alloy has few limitations and is more than sufficiently useful, as measured by utility and ease of use, to include in the TCX framework.

KEYWORDS: Formal Methods, High Assurance Systems, Separation Kernel, Alloy, Morphisms, Model Checker, TCX, LPSK

MAPPING AUTONOMOUS SYSTEMS'S ROUTER-LEVEL TOPOLOGY IN IPV6

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The core of the Internet is composed of many independent and mutually exclusive collections of routers, called autonomous systems, which are responsible for moving traffic between communicating end-systems, or hosts, regardless of the relative location of those hosts. The complexity of the internal composition of these autonomous systems is such that accurate documentation of their topology, referred to as mapping, is difficult and prone to error. Developing automated support for this effort remains an area of active research, the potential benefit of which is the ability to actively monitor the health of the Internet across these autonomous systems, making it possible to identify critical infrastructure chokepoints before their failure adversely impacts the network or national security. The Internet is transitioning to a new version of the Internet protocol, the fundamental protocol that melds the heterogeneous networks worldwide into a single,

COMPUTER SCIENCE

cooperative whole. Tools, techniques, and tactics developed for the current version, IPv4, may hold promise for adaptation to support the new version, IPv6. This thesis explores several of the IPv4 techniques that hold promise for adaptation, and provides an implementation as a proof of concept.

KEYWORDS: IPv6, Autonomous Systems, Mapping IPv6 Autonomous Systems, Anonymous Resolution, Alias Resolution, Doubletree, Rocketfuel, ATLAS, Router Level Topology

VOIPNET: A SOFTWARE-BASED COMMUNICATIONS TOOL FOR LOW-BANDWIDTH NETWORKS

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Maneuver-element communications can be divided into single-channel voice, data networks, and telephony. Infantry regiments currently can draw sufficient bandwidth to support robust data and telephone networks, providing access to classified and unclassified data/telephone systems. Classified computer networks, such as SIPRNET, are pushed to infantry and artillery battalions via the EPLRS radio system. However, telephone services may or may not be supported due to limited availability of multi-channel digital assets. As a result, the maneuver element's primary means of voice communications media is single-channel radio. Single-channel radio is utilized to communicate with higher, adjacent, and subordinate organizations. While this is a sufficient means of communications, it is half-duplex, cumbersome, unreliable, and subject to availability due to net traffic. Therefore, the preferred media is full-duplex telephone communications. With the advent of EPLRS and the increasing availability of bandwidth at the lower echelons of command, it is advantageous to consider the utilization of existing data networks to provide telephone service to highly mobile commands that lack the digital infrastructure to support access to the digital switched backbone. Voice over Internet protocol (VoIP) may be the solution to deploy full-duplex telephone communications services to bandwidth-deprived organizations via an existing wireless-network infrastructure. The development of a software-based "VoIPNet" would provide critical primary telephone services to highly mobile maneuver elements and redundant telephone networks for service-level organizations, with existing digital switched-backbone access.

KEYWORDS: VoIP, Voice, Internet, Protocol, SIP, RTP, Video, Software, Specification

A NEW SUFFICIENT CONDITION FOR ROBUST INTERDOMAIN ROUTING

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Border gateway protocol (BGP) is currently the only interdomain routing protocol employed on the Internet. It allows tens of thousands of autonomous systems (AS's) to exchange routing information while implementing economic and organizational policies. However, conflicting policies between ASes can cause routing instability and/or unpredictable routing solutions. A system of routers is robust if routing tables always converge predictably, despite router and link failures. Researchers pursue an approach to guarantee BGP robustness through operational guidelines. Existing guidelines for BGP robustness are essentially geared toward satisfying the same sufficient condition for BGP robustness developed by Griffin and Wilfong. In this thesis, it is first shown that there exists a weaker sufficient condition for BGP robustness. A discussion follows on how new guidelines for configuring BGP with a guarantee of robustness may be derived from this new condition. Additionally, various models of BGP behavior are compared and it is shown that the models do not always have equivalent results; sometimes, they have completely different behavior.

KEYWORDS: Border Gateway Protocol, BGP, Interdomain Routing, Robust Routing, Stable Paths Problem, Dispute Wheel, Class-Based Path-Vector System

THE VALUE OF NUMERICAL FORECAST PRODUCTS IN IMPROVING TACTICAL AIR-DELIVERY METHODS

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This thesis develops an agent-based system to analyze meteorological model data and generate statistics for comparison purposes. With this system, it is possible to research the value and level of improvement when utilizing different levels of atmospheric-model resolution for guidance in tactical decision aids. This agent-based system automates the comparison of model data at a location in the model field with environmental data extracted from sensor data obtained from radiosonde launches. Statistics are efficiently generated for the variability of the u and v components of the wind directions, to aid in the rapid determination of the variability of model data and its effects on targeting accuracy. By addressing the interoperability and adaptability of agents, this research demonstrates the usefulness of agents to extract information to rapidly compute mission-planning accuracy.

KEYWORDS: Agent Based System, Model Resolution, Improved Accuracy, Tactical Data Application, Automated Analysis, Data Mining, Numerical Modeling

SENSOR-FAILURE DETECTION THROUGH INTROSPECTION

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The advancement of robotic technology holds many opportunities for military applications. One area of current research is simultaneous localization and mapping (SLAM). SLAM uses a robot's sensors to generate a map of the area while maintaining its current position within that map. SLAM research is built upon the assumption that all sensors are working correctly. Since field conditions are likely to cause erratic sensor function due to damage or inclement weather conditions, this assumption must be addressed.

The goal of this research is to discover methods for effectively performing self-diagnostic checks on robots to detect failures and malfunctions in sensors. There has been little work in the area of error detection in sensors, and what little work has been done has limited applications. During this research, a series of experiments are performed using a variety of error-detection techniques. It is hoped that the methods developed will prove to be applicable to a variety of real-world systems.

KEYWORDS: Error Detection, Sensor Failure, Introspection, Probabilistic Modeling, Autonomous Robots

COMPUTER SCIENCE

PRELIMINARY ANALYSIS OF A TRUSTED-PLATFORM-MODULE INITIALIZATION PROCESS

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As distributed-system architectures, such as peer-to-peer, grid computing, and MANET, become more popular, there is an increasing need for robust and scalable mechanisms to establish trust between entities. The trusted-platform module (TPM) provides for the possibility to establish trust at the hardware level for commercial hardware. While work has been done to leverage TPMs for digital-rights management (DRM) and other schemes, application of TPMs for robust identification and authentication in a MANET or other distributed environment have not been addressed. This research provides a simple analysis on the applicability of leveraging TPMs for enhanced computer security in today's military environment. A military convoy using laptops in a MANET is used as a hypothetical concept of operations. The problem of TPM initialization of a laptop, in particular, at a depot prior to deployment is addressed. The initialization steps that must be performed before using a TPM in any deployment are studied and described, and suggestions are provided to address possible Department of Defense concerns in using this technology.

KEYWORDS: Trusted Platform Module, TPM, MANET, Identification and Authentication, Trusted Computing, Information Assurance, Telecommunication Security, Cryptography, Initialization

MASTER OF SCIENCE IN CONTRACT MANAGEMENT

A HANDBOOK FOR CONTRACTING OFFICERS

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The purpose of this research is to develop and field a contracting-officer/team-leader handbook. Multiple factors have led to an environment that is less than optimal for the accomplishment of the acquisition mission. There has been a significant loss of corporate knowledge in the communications-electronics lifecycle-management command (C-E LCMC) workforce, combined with acceleration in promotions to the GS-13 level. The experience of contracting officers is limited because of rapid promotions. In the past few years, the organizational culture focused more on cycle-time reductions, versus quality of product, to satisfy the needs of customers. In addition, since the supervisory role was raised to the GS-14 level and GS-13's were relieved of supervisory responsibility, there has been increased confusion as to the role of team leader. Initial research suggests that contracting officers/team leaders need another resource to support them in their duties. The C-E LCMC Acquisition Center's strategic plan for the next twelve-month period sets forth a vision of a new business culture, one that defines competency at three different levels. The first level is "do:" be able to repeat a complex task consistently; level two is "understand why:" apply learned knowledge to the next problem and next task, refining and improving execution each time; level three is "explain the why:" master knowledge and skills for ability to teach and explain, leading others to competency. The plan is to enhance workforce skills, ensure contracting is done right, and focus on leadership development. The objective of this project is to align with the plan and produce a guide that supports contracting officers/team leaders in technical competence, leadership, and customer relations.

KEYWORDS: Contracting, Acquisition, Contracting Officer, Contracting Methods

MASTER OF SCIENCE IN DEFENSE ANALYSIS

TRANSFORMING CHANGE IN THE MILITARY: A SYSTEMS APPROACH

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Why are military organizations resistant to change? In an attempt to answer this question, this thesis proposes the use of systems thinking to evaluate the military and its ability to effect change. Rather than investigate individual components of the environment, systems thinking dictates the study of the relationships between system components. Two frameworks are offered to examine these relationships. The prescriptive framework, developed via literature, illustrates how each of the military subsystems of strategy, doctrine, and organization should interact. The theoretical framework shows how these subsystems interact in reality. A study of the theoretical framework illustrates differences from the prescriptive framework and where resistance to change within the military system actually occurs. It is found that there are many barriers to change, including doctrinal rigidity and a legacy force structure that is preserved by a dominant culture, the misuse of history, and the inability to learn from past failures.

Systems thinking, as seen through these frameworks, can apply to every military organization and be very useful in not only realizing the need for change but understanding how these changes affect the entire system. More importantly, through systems thinking, the inhibitors to change can finally be realized and understood.

KEYWORDS: Systems Thinking, Learning Organization, Organizational Learning, Change, Inhibitors to Change, Doctrine, Organization, Military Strategy

COMBATING TERRORISM IN THE BRAZILIAN TRI-BORDER AREA: A NECESSARY LAW-ENFORCEMENT STRATEGIC APPROACH

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The whole world is in some way affected by terrorism. It has many faces, different causes, and comes about by distinct ways around the globe. In the Brazilian tri-border area (TBA), terrorist groups are focused on supporting activities for their organizations.

The problems related to terrorism in the TBA are connected with the struggle between Arabs and Israelis in the Middle East. Terrorist groups, such as Hezbollah and Hamas, have operatives in the TBA

DEFENSE ANALYSIS

to raise money and provide logistical support to their groups. These supporting activities are, as a rule, criminal efforts.

Thus, in the TBA, the best statecraft instrument to combat terrorism is law enforcement. In the Triple Frontier, crime is the center of gravity for terrorism; as a consequence, the police are the most capable agency to deal with this situation. They can better prosecute organizations that perpetrate crimes to support terrorist groups.

Hence, Brazil, Argentina, and Paraguay must develop a strategic law enforcement approach to combat terrorism, based on ends, ways and means, with emphasis on police intelligence operations and covert criminal investigations.

KEYWORDS: Tri-Border Area, TBA, Triple Frontier, Terrorism, Organized Crime, Counter-Terrorism, Homeland Security, Law Enforcement, Police, Investigation, Strategy, Tactics

A NON-CONVENTIONAL INTERDICTION STRATEGY FOR THE GLOBAL WAR ON TERRORISM

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The purpose of this thesis is to explore an alternative strategic focus for the Department of Defense to implement in conducting the global war on terrorism. The thesis is as follows: a non-conventional approach to strategic policy, led by an enhanced foreign internal defense concept, and judicious execution of U.S. sponsored unconventional warfare, applied as a primary tool of U.S. national policy through the Department of Defense, will serve as an effective solution to the global “terrorist” threat.

This paper justifies such by analyzing the historical conduct of the United States through the framework of its own doctrine and the “mystic diamond,” a state/counter-state dynamic model as presented by Dr. Gordon McCormick. Elements of the Department of Defense and the Department of State know the operational strategy to take, but are hampered by the misapplication of counter-guerilla tactics as strategy, and are reluctant to use sponsored unconventional warfare (UW) to preempt or curtail the exportation of terrorism. In essence, the Department of Defense has been and continues to be limited by its conventional tactical successes, when what is required is strategic application of foreign internal defense (FID), UW, and limited direct engagement to defeat an enemy employing a non-conventional method of engagement.

KEYWORDS: Global War on Terror, GWOT, Strategy, Foreign Internal Defense, FID, Unconventional Warfare, UW, Counter-Insurgency, COIN, U.S. Army Special Forces, Special Forces, SF, Terrorism

ALTERNATIVE STRATEGIES FOR IRAQ

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This thesis explores strategically viable options for dealing with the Iraq conflict, with a new perspective on the dynamics of insurgency in Iraq and basic guidelines for an unconventional counterinsurgency effort. The thesis presents an overview of the Iraqi situation, describing the actors in the conflict, their political objectives, and the consequences of their actions. The thesis explores the theoretical concepts of the

DEFENSE ANALYSIS

“mystic diamond” model developed by Gordon H. McCormick, which identifies the component variables of insurgencies and the dynamics of conflict between the state and counter-state. The thesis uses the mystic diamond model to interpret the Iraqi situation and explores steps for implementing an unconventional strategy in Iraq, including the skill sets that would be needed by unconventional forces tasked to carry out the proposed strategy. The conclusion emphasizes that the coalition forces have used a conventional strategy to stabilize a totally unconventional and increasingly uncontrollable environment. Political and military leaders are advised to consider the benefits of an unconventional approach when dealing with a counterinsurgency environment.

KEYWORDS: Counterinsurgency, Unconventional Approach

GAME THEORY: TOOLKIT AND WORKBOOK FOR DEFENSE-ANALYSIS STUDENTS

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The purpose of this thesis is to provide a workbook of the game-theory topics covered in the course SO4410, *Models of Conflict*. The thesis also provides a software toolkit, which enables students to solve the problems easier and faster, therefore focusing more on analyses of the situation than on the actual mathematical side of the problem.

The workbook gives a basic review of the fundamental concepts and a detailed explanation for solving “simple” game-theory problems by pen and paper. Topics cover two- and three-person games. Two-person games include 1) zero-sum games and their solutions in pure or mixed strategy, 2) partial-sum games without communication between players, and 3) communication among players and its effect on the game. Three-person games focus on likely coalitions among players.

The toolkit covers two-person zero-sum games, the Nash arbitration scheme, strategic moves, prudential and equalizing strategies in partial-sum games, three-person games, and a supplemental template for linear-programming problems with up to ten variables and thirty constraints.

KEYWORDS: Nash Arbitration, Prudential Strategies, Equalizing Strategies, Saddle Point, Dominant and Dominated Strategies, Strategic Moves, Game Theory, Pareto Optimal, Equilibriums, Rational Player

RETHINKING MILITIAS: RECOGNIZING THE POTENTIAL ROLE OF MILITIA GROUPS IN NATION BUILDING

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Recent media, political, and military consideration regarding the use of militias has been almost totally negative. This conceptual bias against militias is somewhat misguided, and can lead to disastrously counterproductive situations. Conceivably, militias can play a role in building a functioning state, and can support immediate and long-term U.S. and host-nation efforts in these situations. Stability, security, transition, and reconstruction (SSTR) have become a mainstay of current U.S. strategy, but little effort is dedicated to developing options that deal specifically with the inclusion of irregular forces outside the control of a central government. This thesis seeks to counter the bias against militia groups, and provides a framework for analyzing militias’ potential to assist with establishing governance in weak and failing states. Second, it analyzes a series of examples and arrays them along a spectrum that can be used to better

DEFENSE ANALYSIS

define militias' characteristics and intents. The third aim of this thesis is to offer a set of strategy options the U.S. might apply in its efforts to deal with militias in its nation-building efforts.

KEYWORDS: Political, Military, Militias, Militia Groups, Government, Stability, Security, Transition, Reconstruction, SSTR, Control, Irregular Forces, Weak and Failing States, Strategy Options, Host Nation Government, Nation-Building

MORTUS DISCRIMINATUS: PROCEDURES IN TARGETED KILLING

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Currently, no widely established standard or published set of guidelines and planning considerations exist for operational planners to conduct targeted-killing operations. Due to the political complexity intertwined with targeted killing, these types of operations rarely occur without repercussion. Operational planners need to understand that targeted-killing operations cannot exist solely at the operational level because their consequences have strategic and political ramifications. By utilizing a case-study analysis, this thesis identifies the operational-planning considerations that need to be addressed to successfully conduct a targeted-killing mission. This thesis also outlines any guidance the operational team should receive when tasked with a targeted-killing mission. This will enable the operational unit to minimize any unintended consequences that result from targeted killing. Minimizing unintended consequences will assist in removing the aura of illegitimacy surrounding targeted-killing operations because transparency is provided on the procedures and planning considerations that are involved in the execution of these operations.

KEYWORDS: Targeted Killing, Assassination, Political Killing, Operational Planning, Planning Considerations, Operational Politics, Killing Strategy, Covert Strategies, War Planning, Targeting Methods, Capture versus Kill, Manhunting, Military Operations, National Security Strategy

SATAN VS. SATAN: THE USE OF BLACK PSYOP TO REGAIN THE TACTICAL INITIATIVE IN THE COUNTERINSURGENCY FIGHT

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In the counterinsurgency fight, the insurgent has the tactical initiative because he is able to pick the time, place, and intensity of his own engagements. The insurgent's environment, however, is very difficult despite his initiative. The insurgent must balance the mutually exclusive requirements of hiding (operational security) and fighting (operational effectiveness) in order to gain/maintain legitimacy without being prematurely destroyed by the state. What if the state could influence this balance? What if there was a way for the state to directly target the insurgent's resource allocation between these competing requirements? Typically, states attempt this through influencing the population to support the state and reject the insurgent. But what if the state could use the insurgent's own propaganda machine against itself? Through mathematical modeling, it is shown that Black PSYOP enables the state to make strategic moves on behalf of the insurgent; these moves are so detrimental to his cause that he must act in order to counter "his own" moves. In this way, the state is able to turn "Satan" against himself. "How shall then his kingdom stand?" (Matthew 12:26).

KEYWORDS: Black PSYOP, Black Propaganda, Deception, Counterinsurgency, Reflexive Control, Tactical Initiative, Guerrilla Warfare

DEFENSE ANALYSIS

FINDING THE MISSING LINK TO A SUCCESSFUL PHILIPPINE COUNTERINSURGENCY STRATEGY

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This paper analyzes the current Philippine counterinsurgency strategy in relation to the Philippine government's past experiences fighting insurgency nationwide. The Philippine government recognizes insurgency as a national threat that hampers sustained peace and development in the country, but government efforts in counterinsurgency have been less than successful.

The thesis examines four historical case studies: the "all-out friendship or all-out force" program of President Ramon Magsaysay against the Huk rebellion in 1950s; the "Oplan Katatagan" during the Martial Law Era under President Ferdinand E. Marcos; the Lambat-Bitag campaign during the administrations of presidents Corazon Aquino and Fidel V. Ramos; and "Operation Enduring Freedom-Philippines" in the current administration of President Gloria Macapagal-Arroyo. The thesis demonstrates that successful counterinsurgency operations require a collaborative, interagency approach based on a clear and logical national strategy. This strategy cannot succeed at the national level only. The strategy must be pushed down to the local level where effective change can occur. Despite current perceptions, counterinsurgency operations are not the exclusive domain of the military. In fact, the possibility of success is often diminished when the military takes a dominant role in counterinsurgency operations. Finally, the thesis recommends that the Philippine government should internalize and adopt the "correct attitude" that has been missing in most of the early counterinsurgency efforts. Although focused on the Philippines, lessons from this thesis can be applied elsewhere.

KEYWORDS: Government of the Republic of the Philippines, GRP, Counterinsurgency, COIN, National Internal Security Plan, NISP, Barangay Village

XENOPHON'S *ANABASIS*: LESSONS IN LEADERSHIP

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The purpose of this thesis is, paradoxically, to provide a fresh perspective on leadership, particularly military leadership, by returning to a piece of classic literature. It is not about defining leadership, or presenting an argument in defense of one leadership theory or another. It is about analyzing, from the classical historian's as well as the professional soldier's perspective, one of the greatest examples of leadership in written history: Xenophon's *Anabasis*. This thesis extracts from Xenophon's work a wide range of the characteristics and principles of leadership and discusses concrete examples of their use. Some of the principles and characteristics presented are no doubt familiar, such as leading by example, building morale, and instilling discipline. Others, such as consensus decision making, piety, and brutality might be controversial. All the principles, however, from balancing contradictions to gathering information, share one significant and inescapable truth: one man, using the principles laid out in the pages that follow, facing inhospitable terrain and weather, supply and food shortages, internal dissent, and external hostility, successfully led ten-thousand disparate Greek mercenaries on one of the greatest adventures and survival expeditions in written history.

KEYWORDS: Xenophon, *Anabasis*, Greek, Leadership, Morale, Discipline, Example, Adaptability, Ethics

DEFENSE ANALYSIS

THE CYCLE OF RECIPROCITY: A SOCIAL-CAPITAL INTERVENTION STRATEGY FOR SECURITY, STABILITY, TRANSITION, AND RECONSTRUCTION

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Is it possible to initiate and sustain a positive cycle of reciprocity between competing actors in a security, stability, transition, and reconstruction (SSTR) environment? The author postulates that an intervention strategy based on “bridging social capital” between two or more competing parties stands a greater probability of success than an intervention strategy based primarily on an infusion of physical or human capital. The author reviews key literature on social capital and examines two cases involving a harvest initiative in Gnjilane, Kosovo (July–September 1999) and the “Village of Hope” in Mosul, Iraq (January–December 2004). Examination of these two instances of convincing recalcitrant ethnicities to cooperate for the greater good yields lessons in civil–military relations and provides a template for intervention and generating “bridging” social capital. Current practices in SSTR operations inadvertently establish a competitive dilemma by introducing significant amounts of fiscal and physical capital in a post-conflict environment. Ethnic groups compete with other groups for financial, human, and information capital—to the detriment of the collective civil good. Recommendations for civilian and military interventionists include bringing competing ethnicities together in common, low-level, microfinancial projects that foster bridging social capital between kinship-based social networks.

KEYWORDS: Gnjilane, Kosovo, Mosul, Iraq, Village of Hope, Harvest Initiative, Social Capital, Reciprocity, SSTR, Maslow, Intervention, KFOR, Game Theory, Prisoner’s Dilemma, Civil Affairs, Humanitarian Aid

OPTIMIZING ARMY SPECIAL-FORCES LEADERS IN A GLOBAL COUNTER-INSURGENT NETWORK

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Since the watershed events of September 11, 2001, the United States military has been engaged in fighting what has been recognized as a highly organized and networked global insurgency. These global insurgents have sought to take advantage of all the technological advances available in the current information age, combined with the innovative and adaptive advantages of networked organizations.

This study asks two questions: 1) how can global insurgent networks be countered, and 2) where might the most appropriate personnel to man a global U.S. counter-insurgent network be found? This thesis asserts that organizational considerations matter and that for the U.S. military to have the best chance to defeat these global insurgent networks, it must further develop small, adaptive, human networks of its own. Second, the authors demonstrate that there exists within Army special-forces field-grade officers the capability and capacity to man and lead a small, yet globally dispersed, counter-insurgent network.

These arguments are evidenced by an examination of the networked aspects of the global insurgency, hierarchical aspects of the U.S. military, and finally, the specific manpower data within the Army’s special-forces officer population. What is still needed in the evolving global war on terrorism, and what this study hopes to contribute, is a small turn of mind towards applying networked counterterrorism organizations against a very serious, irregular, networked threat. To this end, the authors propose the establishment of a special-forces, global, counter-insurgent network.

DEFENSE ANALYSIS

KEYWORDS: Global War on Terror, GWOT, U.S. Army Special Forces, Network, Counter-Insurgency, COIN, Fourth Generation Warfare, 4GW, Human Resources, Special Operations, Field-Grade Officers, Warrant Officers, Global Persistent Presence

BUILDING A VIRTUAL CULTURAL-INTELLIGENCE COMMUNITY

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The U.S. intelligence community is without peer in providing high quality, detailed, technical intelligence. Due to the intelligence community's efforts, the USG has a thorough understanding of its adversaries' activities. Researchers propose to develop a means by which that same intelligence community can use cultural factors to answer the question, "why?" Although cultural intelligence plays a key role in many of America's political and military successes, the maintenance of a broad-based, detailed, cultural intelligence capability has thus far proven elusive. With the advent of networked collaboration tools, intelligence now has the ability to deploy a virtual cultural-intelligence community. Such a community, based on a wiki, would incur almost no monetary or bureaucratic overhead and could be configured so that the loss of any single intelligence organization would have minimal negative effect on a mission.

KEYWORDS: Cultural Intelligence, Cultural Wiki, Blog, Virtual Intelligence Community, Open Source

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

FEASIBILITY OF A DYNAMIC-DATA-RATE SATELLITE LINK FOR INMARSAT

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Inmarsat is a predominantly commercial satellite system fitted on most U.S. Navy surface vessels, including frigates, cruisers, destroyers, amphibious ships, and mine sweepers. It is primarily used for telephone, fax, email, web browsing, and the global command-and-control system (GCCS). Inmarsat, however, has a very limited data rate. For ships fitted with the latest modem upgrade, Inmarsat provides a meager 128 kbps for support of its numerous functions. To improve upon Inmarsat's data rate, this thesis suggests a potential improvement to Inmarsat communications by integrating a dynamic-data-rate link that maintains the required probability of bit error without exceeding the allocated bandwidth. The results from this thesis show that link margin provisions from the static data-rate design are able to support much greater data rates using advanced modulation and forward error-correction techniques. The proposed adaptive, dynamic link improves the link by measuring channel conditions to determine the fastest data rate for successful communications. When channel conditions are good, the adaptive, dynamic link will communicate at a high data rate, and when poor, at a lower data rate to maintain a target probability of bit error ceiling.

KEYWORDS: Inmarsat Satellite, Satellite Communications, Dynamic Link, Link Budget, Variable Modulation, Variable Data Rate

PERFORMANCE OF WIRELESS, UNATTENDED, SENSOR NETWORKS IN MARITIME APPLICATIONS

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Wireless, unattended, sensor networks offer superior monitoring capability with unparalleled flexibility. Traditional systems are typically restrictive in the rigidity of their positioning and topological design requirements. Ongoing research continues to expand the potential for use of these untethered and autonomous systems, ranging from the mundane (monitoring soil conditions for agricultural crops) to the extreme of military operations (providing valuable intelligence to commanders in a variety of battle-space conditions). This thesis investigates the use of this type of system in what may be the most hostile of environmental conditions from a wireless networking and communications point of view: water. The network is required to organize, establish, and maintain itself in a variety of dynamic conditions in or on the water. Commercial, off-the-shelf products developed by Crossbow Technologies are used in developing the wireless, unattended, sensor network, which consists of single- and multiple nodes. Nodes are tested on a solid ground surface, on the surface of water, below the surface (not submerged), and fully submerged. The most significant findings are attained with regard to range. Other findings with regard to link quality, network formation, and network-stability support results attained in previous research.

ELECTRICAL ENGINEERING

KEYWORDS: Wireless Sensor Network, TinyOS, XMesh Routing Protocol, Network Stability, Link Connectivity

PERFORMANCE ANALYSIS OF IEEE 802.11G TRELLIS-CODED MODULATION WAVEFORMS TRANSMITTED OVER A CHANNEL WITH PULSE-NOISE INTERFERENCE

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Trellis-coded modulation (TCM) is a technique that introduces forward-error correction (FEC) coding without increasing the bandwidth of the channel signal. TCM combines binary convolutional codes with M-ary modulation in one operation. In this thesis, the performance of the TCM mode of the IEEE 802.11g wireless, local-area-network standard is investigated. The waveform is assumed to be transmitted over a channel with both additive white Gaussian noise (AWGN) and pulse-noise interference (PNI). In addition to a TCM waveform consisting of a rate $r=2/3$ convolutional code with 8-phase-shift keying (8-PSK) modulation (analogous to the IEEE 802.11g TCM mode), modifications to the TCM system are considered. Specifically, a TCM system consisting of two rate $r=1/2$ convolutional codes independently encoding data that is modulated on the I and Q channels, respectively, with 4-pulse amplitude modulation (4-PAM) is examined for both AWGN and PNI. For both TCM systems, the effect of varying the number of encoder memory elements when PNI is present is examined. Finally, a non-TCM system that utilizes a rate $r=2/3$ convolutional code with hard decision decoding (HDD) and 8-PSK modulation is considered, and the effects of PNI on this system are compared with the effects of PNI on the TCM systems considered. For the TCM systems, it is found that as the number of encoder memory elements increases the negative effect of PNI decreases. An analogous result is obtained for the non-TCM system, but the absolute performance of the non-TCM system is significantly poorer than that of comparable TCM systems.

KEYWORDS: IEEE 802.11g WLAN Standard, Trellis Coded Modulation, Hard Decision Decoding, Pulse-Noise Interference, Additive White Gaussian Noise, 8-PSK, 4-PAM

INDIUM-GALLIUM-NITRIDE, MULTI-JUNCTION, SOLAR-CELL SIMULATION USING SILVACO ATLAS

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This thesis investigates the potential use of wurtzite indium gallium nitride as photovoltaic material. Silvaco Atlas is used to simulate a quad-junction solar cell. Each of the junctions is made up of indium gallium nitride. The band gap of each junction is dependent on the composition percentage of indium gallium nitride and gallium nitride within indium gallium nitride. The findings of this research show that indium gallium nitride is a promising semiconductor for solar cell use.

KEYWORDS: Solar Cell, Photovoltaic Device, Indium Gallium Nitride, Silvaco Atlas

ELECTRICAL ENGINEERING

INDEPENDENT COMPONENT ANALYSIS BY ENTROPY MAXIMIZATION (INFOMAX)

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This thesis explores the “infomax” method of independent component analysis (ICA) to accomplish blind source separation (BSS). The infomax method separates unknown source signals from a number of signal mixtures by maximizing the entropy of a transformed set of signal mixtures, and is accomplished by performing gradient ascent in MATLAB. This work specifically focuses on small numbers of two types of signals: audio signals and simple communications signals (polar non-return to zero signals). The infomax method is found to be successful and efficient only for small numbers of signals, and improvements to the gradient ascent algorithm should be made for the infomax algorithm to succeed for more than three signal mixtures. MATLAB implementation code is included as appendices.

KEYWORDS: Blind Source Separation, Gradient Ascent, Information Entropy, Independent Component Analysis, Infomax, Polar Non-Return to Zero Signal

LINEAR AND PLANAR ARRAY FORMATION IN WIRELESS SENSOR NETWORKS

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Wireless-sensor networking (WSN) is a relatively new field of research with many applications, both military and commercial. In military applications, WSNs could be used in hostile environments to minimize the need for a human presence. A WSN consists of a large number of small sensor nodes that are deployed in an area of interest for collecting information. A subgroup of nodes then collaborate their transmissions to achieve beam-forming. The information collected by the WSN is relayed to an unmanned aerial vehicle, which is synchronized with the transmission beam of the network. In this study, the positioning of the nodes in a WSN is investigated, with the main objective of proposing a method to find the best combination of nodes for beam-forming given a random distribution in the sensor field. Additionally, the method is expandable in two dimensions and capable of forming a planar antenna array, which will improve the beam-forming gain. A simulation model is developed in MATLAB code to study the formation of linear and planar antenna array of nodes. The existing iterative technique in the formation of a linear antenna array is compared with the proposed technique and the results show an improvement in linearity.

KEYWORDS: Sensor Networks, Array Formation, Distributed Sensor Network

A HYBRID, LARGE-SCALE, WIRELESS-SENSOR NETWORK FOR REAL-TIME ACQUISITION AND TRACKING

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This thesis proposes a hybrid, large-scale, wireless-sensor network (WSN) designed to support real-time target detection and tracking of multiple ballistic-missile threats. In particular, the proposed WSN consists

of terrestrial and satellite nodes. The infrared (IR) signatures presented by the target-background combination are explored and modern IR-sensor technologies are examined in search of a suitable IR sensor for the proposed hybrid, large-scale WSN. A multicolor, quantum well, infrared-photodetector, step-stare, large-format, focal-plane array is proposed and evaluated through performance analysis.

The thesis proposes an efficient data-dissemination mechanism, as well as a suitable medium-access control (MAC) scheme for the proposed WSN, designed to meet the real-time and accuracy requirements without introducing excessive overhead and increased end-to-end time delays. A clustering mechanism, called the “area of interest” (AOI) is introduced, which combines the content-based feature of the data-centric routing approach with the principles of in-network data aggregation and clustering. Simulation results verify that aggregation within the AOI improves the data throughput across the full range of network load. A contention-based MAC scheme (carrier-sense multiple access) and a contention-free approach, (time-division multiple access), are examined. Performance analysis and simulation results indicate that a contention-free approach is suitable for implementation in wireless networks associated with large propagation delays and increased offered loads. MATLAB and OPNET Modeler software are used to simulate and evaluate the proposed schemes.

KEYWORDS: Wireless Sensor Networks, WSN, Real-Time Target Tracking, IR Sensor, Quantum Well Infrared Photodetector, QWIP, Focal Plane Array, FPA, Data Centric Routing, In-Network Data Aggregation, Clustering Mechanism, Medium Access Control, MAC, Carrier Sense Multiple Access, CSMA, Time Division Multiple Access, TDMA

MULTISTAGE SECURITY MECHANISM FOR HYBRID, LARGE-SCALE, WIRELESS-SENSOR NETWORKS

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A wide-area network consisting of ballistic-missile defense satellites and terrestrial nodes can be viewed as a hybrid, large-scale, mobile, wireless-sensor network. Building on research in the areas of the wireless-sensor networks (WSN) and the mobile, *ad hoc* networks (MANET), this thesis proposes an efficient, multistage security mechanism for node and data authentication and data confidentiality. Node authentication is provided by digital signatures and the public key infrastructure (PKI). The TESLA algorithm and IPSec are utilized for data authentication and confidentiality, respectively. Performance analysis and simulation results demonstrate that the proposed mechanism meets the real-time data dissemination requirements of a ballistic missile defense system while maintaining throughput commensurate with unencrypted Internet Protocol (IP).

KEYWORDS: Wireless Sensor Network, Ballistic Missile Defense, Authentication, Security Mechanism, Digital Signatures, TESLA Algorithm

ELECTRICAL ENGINEERING

PERFORMANCE ANALYSIS OF A VARIABLE DATA RATE TRELLIS-CODED MODULATION WAVEFORM TRANSMITTED OVER A CHANNEL WITH ADDITIVE WHITE GAUSSIAN NOISE AND PULSE-NOISE INTERFERENCE

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Trellis-coded modulation (TCM) is a technique where forward error correction coding and modulation are treated in a single operation without increasing the channel bandwidth. In this thesis, the performance of a variable data rate TCM waveform transmitted over a channel is investigated. In general, TCM systems with rate $1/2$ and rate $2/3$ convolutional codes and quadrature-phase-shift keying (QPSK) and 8-phase-shift keying (PSK) modulation, respectively, are considered for two cases. In the first case, the number of memory elements K remains constant as the code rate increases. In the second case, the number of memory elements increases linearly with code rate, so that the total number of memory elements for 8-PSK, $r=2/3$ TCM is given by $K = 2K_{1/2}$, where $K_{1/2}$ is the number of memory elements for the QPSK, $r=1/2$ convolutionally encoded TCM. The effects of pulse-noise interference, in addition to additive white Gaussian noise, are considered. It is found that TCM systems have significant resistance to PNI when K is large enough.

KEYWORDS: TCM, Trellis Code Modulation, Convolutional Codes, AWGN, Pulse-Noise Interference, QPSK, 8-PSK

REAL-TIME, SPEECH-RECOGNITION SYSTEM FOR ROBOTIC-CONTROL APPLICATIONS USING AN EAR MICROPHONE

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This study is part of a project started in 2004 at the Naval Postgraduate School to investigate the development of a human-machine interface, command-and-control package for controlling robotic units in operational environments. An ear microphone is used to collect voice-activated commands, providing hands-free control instructions in noisy environments [Kurcan, 2006; Bulbulla, 2006].

This study presents the hardware implementation of a theoretical isolated-word recognition (IWR) system designed in an earlier study. The recognizer uses a short-term energy, zero-crossing-based detection scheme and a discrete hidden-Markov model recognizer designed to recognize seven isolated words. Mel-frequency cepstrum coefficients (MFCC) are used for discriminating features in the recognizer phase. The hardware system implemented, using commercial, off-the-shelf electronic components, in-ear microphone, is portable and costs under fifty dollars.

The speech-capturing system implemented uses an ear microphone and the Si3000 audio codec to capture and sample speech clearly. The microprocessor processes the detected speech in real-time. The microprocessor's I/O devices work effectively with the audio codec and computer for sampling and training, without communication problems or data loss. The current implementation uses 1.181 msec to process each 15 msec data frame. Resulting recognition performances average around 73.72%.

KEYWORDS: Speech Recognition, Discrete Hidden Markov Model, Short-Term Energy, Zero-Crossing Measure, Real-Time Isolated Word Recognizer, Robotic Control, Human-Machine Interface, End-Point Detection, Microprocessor, Microchip, Audio Codec, Speech Capturing System

ELECTRICAL ENGINEERING

CONTROL OF A SYSTEM IN THE PRESENCE OF FLEXIBLE MODES

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The primary research objective is to investigate the control of flexible-space structures—mobile satellite communication systems in particular. Solar-powered satellites require a high level of accuracy in attitude stabilization and large-angle maneuvering. Furthermore, they have to be least sensitive to disturbances affecting the structure, possibly coming from several sources, such as mechanical vibrations due to flexible panels appended to the spacecraft. The problem of robust adaptive disturbance rejection in a control system of a flexible structure is addressed in this thesis. The intent is to guarantee stability and maximum rejection of the disturbances. To achieve this goal, a linear quadratic Gaussian controller is designed using loop-transfer recovery to increase the robustness of the system. A second approach is to design a non-minimum-phase structural filter and to examine its effect on the system's stability.

KEYWORDS: State Space Analysis, Linear Quadratic Gaussian Controller, Loop Transfer Recovery Approach

DISTRIBUTED ALGORITHMS FOR BEAM-FORMING IN WIRELESS-SENSOR NETWORKS

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Sensor nodes in a wireless-sensor network (WSN) can establish a link with an unmanned, aerial vehicle (UAV) by using beam-forming techniques to form a random array with position errors. The effect of the position errors in the array performance is examined using a MATLAB-based simulation model.

In order to spread the processing and communication load among the nodes, two new distributed algorithms for beam-forming in wireless-sensor networks (WSN), based on the least squares (LS) approximation of the desired array response, are proposed. The first is a distributed implementation of the QR decomposition. The second is an iterative method for solving the LS problem. Results indicate that the processing load is effectively shared among the nodes. In the second approach especially, the processing load can be lower than that of the centralized approach, depending on the algorithm's convergence. For both algorithms, the tradeoff for the ability to spread the processing load is the increased communication cost, which could cause an overall increase in total power consumption in the network. However, the average power per participating sensor node is still lower than that required by the cluster head in the centralized approach. Consequently, the network's susceptibility to failures due to excessive power consumption is greatly reduced.

KEYWORDS: Wireless Sensor Networks, Distributed Beam-forming, Distributed QR Decomposition, Iterative Least Squares

ELECTRICAL ENGINEERING

TRACK-SCORE PROCESSING OF MULTIPLE DISSIMILAR SENSORS

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In this thesis, a data-fusion problem involving a number of different types of sensors deployed in the vicinity of a ballistic missile launch is studied. An objective of this thesis is to calculate a scoring function for each sensor track; the track file with the best (optimum) track score can then be used for guiding an interceptor to the threat within the boost phase. Seven active ground-based radars, two space-based passive infrared sensors, and two active light detection and ranging (LIDAR) sensors are used to track the ballistic missile in the boost phase. Each space-based platform carries one passive infrared sensor and one LIDAR. For the threat scenario, an IMPULSE intercontinental ballistic missile model is used to create the trajectory of a generic ballistic threat. The IMPULSE model is developed by the National Air and Space Intelligence Center to provide an accurate representation of ballistic missiles. Each sensor provides a track of the missile in the boost phase by using a multiple hypotheses tracking algorithm with an extended Kalman filter. The calculation of the track scoring function is to identify the sensor with the best track file. A track score is calculated for each sensor based on the kinematics of the missile flight parameters and the signal-to-noise ratio at the sensor. By using likelihood ratios, the optimum track file of the threat can then be determined, and the corresponding track file can be transmitted to the battle manager control in order to lead the interceptor vehicle against the threat using the track file with the best score. Using the optimum track file scoring signal processing techniques developed in this thesis, the best track file can be sent to the interceptor to destroy the ballistic threat. This leads to faster response management, where the threat can be destroyed inside the territory of the country that launched the threat before any countermeasures are deployed.

KEYWORDS: TERMS Ballistic Missiles, Defense Networks, IR and LIDAR Sensors, Space-Borne Sensors, Data Fusion, Likelihood Ratios

EXTENDING THE RANGE OF THE 802.11G WLAN THROUGH IMPROVED SYNCHRONIZATION TECHNIQUES

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Orthogonal frequency-division multiplexing (OFDM) allows for a spectrally efficient means of obtaining high data rates while simultaneously combating the effects of fading. The multicarrier spectrum of OFDM mandates that the receiver accomplish a number of synchronization tasks to successfully demodulate the OFDM signal, including the critical requirement to synchronize the carrier frequency. Additional synchronization tasks include frame synchronization (packet detection), synchronization of the carrier phase, and symbol timing. Improved receiver synchronization algorithms may hold the prospect of superior performance; specifically, allowing successful demodulation by the receiver at an extended range. This thesis discusses several promising synchronization algorithms. Furthermore, a performance analysis of these algorithms is conducted at low signal-to-noise ratio (SNR) in an AWGN channel using MATLAB.

KEYWORDS: OFDM, Orthogonal Frequency Division Multiplexing, 802.11, 802.11g, AWGN, OFDM, Synchronization, Carrier Synchronization, Frequency Synchronization, Phase Synchronization, Symbol Synchronization, FFT, IFFT, Cyclic Prefix, Guard Interval, Wireless LAN

ELECTRICAL ENGINEERING

OPTICAL FLOW ANALYSIS AND KALMAN-FILTER TRACKING IN VIDEO-SURVEILLANCE ALGORITHMS

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A Simulink-based algorithm for monitoring contacts in a surveillance video sequence using optical flow analysis and Kalman filters is developed. The Horn-Schunck optical flow algorithm is used to identify contacts in a surveillance video sequence. The position and behavior of these contacts is monitored by a modification of the traditional Kalman filter. The Kalman-filter algorithm implemented has the ability to track up to ten contacts at a time, correctly assigning each of a maximum of ten filters to their respective contacts on a frame-by-frame basis. Initial tests using artificial data show good performance of both the optical flow-analysis algorithm and the Kalman-filter tracking algorithm. Surveillance video data is also used to test the algorithm, with promising results.

KEYWORDS: Optical Flow, Kalman Filter, Horn-Schunck, Surveillance, Video Processing, Contact Tracking, Morphological Operations

PC104 CONTROL-ENVIRONMENT DEVELOPMENT AND USE FOR TESTING THE DYNAMIC ACCURACY OF THE MICROSTRAIN 3DM-GX1 SENSOR

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There is a need for a standard, accurate test bench for inertia-based orientation sensors. Static accuracy testing of these sensors is straightforward, but dynamic accuracy testing is more difficult. A test-bench system is developed with encoders and a PC104 computer under the QNX Neutrino real-time operating system. A Microstrain 3DM-GX1 inertial sensor is used as the sensor to be tested. The dynamic error of this sensor is accurately recorded and found to be a function of the sensor velocity and acceleration.

KEYWORDS: PC104, MicroStrain, 3DM-GX1, 16-Bit Absolute Encoder, Controls Environment, Inertia-Based Orientation Sensor

EFFECTS OF WIRELESS CHANNEL, SIGNAL COMPRESSION, AND NETWORK ARCHITECTURE ON SPEECH QUALITY IN VOIP NETWORKS

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In this thesis, the quality of vocal reception through digital communications is measured. Factors that affect the quality of the received voice in voice-over-internet protocol (VoIP), such as channel status, compression ratio, and channel coding, are quantified. Both simulation and experimentation is executed, using MATLAB and commercial VoIP networks, respectively. Simulation results show that the signal-to-noise ratio is a determining factor on the signal's bit-error rate. Secondary path signal strength and delay variation heavily affect voice quality in multipath scenarios, and compression makes speech more sensitive to errors. Convolutional coding is a key factor for speech quality improvement.

ELECTRICAL ENGINEERING

Experimentation shows that indoor local-area networks (LANs) are more prone to errors than outdoor LANs due to multipath, and long distance VoIP voice quality depends on the time of day the communication takes place.

KEYWORDS: Voice Quality, Digital Communications, Channel Coding, VoIP, Fading Channel, Voice Compression

FILTER-BANK APPROACH TO THE ESTIMATION OF FLEXIBLE MODES IN DYNAMIC SYSTEMS

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Master of Science in Electrical Engineering-June 2007

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

The problem of estimating frequencies of sinusoids buried in noise has been of great interest in both military and civilian applications. In particular, in control systems with flexible appendages the sinusoidal vibrations can cause instabilities and degrade the performance of the overall system. In this thesis, the problem of identifying frequencies of disturbances in flexible systems using advanced digital-signal processing techniques, such as filter banks and quadrature mirror filters, is addressed. In a number of situations there is a need to design a controller for a system with flexible modes. In space applications in particular, solar panels and robotic arms introduce flexible modes in the system, which degrades performance. In these kinds of applications, the frequencies of the flexible modes cannot be modeled accurately *a priori* and they can change according to operating conditions. The proposed approach is tested by computer simulations.

KEYWORDS: Frequency Estimation, Filter Banks, Daubechies Filters, Discrete Fourier Transform, Finite Impulse Response, Flexible Structure Space, Inverse Discrete Fourier Transform, Proportional Integral Derivative, Quadrature Mirror Filter, Signal-to-Noise Ratio, Wide Sense Stationary

PARTIAL BAND JAMMING AGAINST 802.16A

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Master of Science in Electrical Engineering-June 2007

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The IEEE 802.16a standard provides for broadband wireless access (BWA) for the global deployment of broadband wireless, metropolitan-area networks (WMAN). Commercially known as Wi-Max, the standard aims to provide large amounts of wireless data over long distances, in a cellular-type structure with base and subscriber stations. The standard uses orthogonal-frequency-division multiplexing, which allows the transmission of high data rates in severe channel conditions without complex filters. This thesis tests the performance of a developed partial band-jamming algorithm on a modified 802.16a standard. The partial band jamming was applied to $1/8$, $1/4$, and $1/2$ of the total subcarriers. Additionally, both intentional and unintentional interference were added to the signal. The modified code repeated the signal 48, 96, or 192 times, and recombined the data using maximal ratio combining. This thesis explores the potential for performance gains by reducing the data rate with a repetition code. The evaluation was performed in MATLAB.

KEYWORDS: IEEE 802.16a, WMAN, OFDM, OFDMA, BWA, Wi-MAX, Multipath, Interference, Maximal Ratio Combining

MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

IMPROVING THE VISUAL PERCEPTION OF SONAR SIGNALS WITH STOCHASTIC RESONANCE

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Master of Science in Engineering Acoustics-June 2007

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The goal of this research project is to improve the detection of low-level tonals in low-frequency array (LOFAR) grams by reducing the negative effects of background noise using stochastic resonance. Stochastic resonance (SR), in general, is a phenomenon whereby the effect of low-level signals is enhanced through the addition of noise. It has been invoked as an explanation for a wide range of observations, from the periodicity of ice ages to the behavior of crayfish neurons. Recent work has focused on the possibility of applying it to image processing. Both static and moving image improvements have been reported. The basic technique behind the use of stochastic resonance in image processing is to first add a random amount of noise to each pixel in the image. Second, a threshold is applied to the image, so that pixels above the threshold are rounded up to the maximum pixel value, and pixels below the threshold are rounded down to the minimum. The images produced can either be averaged into a single image, or shown in series as a movie. In this thesis, a simulated signal is created and tested to find the amount of noise to add and the threshold to apply in order to maximize the signal-to-noise ratio of an averaged image. It is found that the best result is produced when a threshold is applied without adding any additional noise. This finding shows that the process does not demonstrate stochastic resonance for static images. A theoretical analysis of this result is provided. Although no improvement in the moving images is obvious, an SR effect in the optical nerves cannot be ruled out at this time. A future experiment that would use human test subjects to determine whether or not SR movies can be used to improve the detectability of low-level signals is recommended.

KEYWORDS: LOFAR, Sonar, Stochastic Resonance, Image Processing, Undersea Warfare

MASTER OF SCIENCE IN INFORMATION OPERATIONS

THE MAKARA OF HIZBALLAH: DECEPTION IN THE 2006 SUMMER WAR

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Master of Science in Information Operations-June 2007

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Information, while always a critical element of warfare, is quickly becoming decisive in present-day conflicts. While the use of this information can take many forms, one area where the discussion of information's impact on conflict has been delinquent is in the art of deception.

Hizballah and Israel serve as the perfect backdrop to examine the effects of deception in current conflicts. While Israel has always maintained a hard-power advantage through its military might and prowess, Hizballah looked for other ways to level the playing field. The use of information in supporting deception, which has been a key enabler for the weaker side, became one of the answers to redressing the military imbalance.

This paper demonstrates that Hizballah, fighting an asymmetric conflict with Israel, used deception very effectively in their defense of southern Lebanon during the 2006 Summer War; this use of deception significantly offset many of Israel's hard-power advantages. This research also shows that Hizballah's use of information technologies greatly enhanced their ability to wield deception. Finally, this paper addresses the interrelation of various information activities and the need to maintain consolidation of these activities for planning and execution on the modern battlefield.

KEYWORDS: Terrorism, Hizballah, Information Operations, Deception, Israel, 2006 Summer War

HOMEGROWN TERROR: THE UNITED KINGDOM AS A CASE STUDY

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This thesis sheds light on the causes for and recurrence of such terrorist phenomena as the London transit bombings. This thesis makes three central claims: that a British policy of multiculturalism enables the actions of a new generation of "homegrown" jihadis; that the evolution of jihadi thought through the ages has resulted in a situation in which Islamic extremists find justification for indiscriminate targeting, such as occurred in the London transit bombings; and that various socio-economic factors at the very least serve as indicators of likely problems—if they are not actually causal.

KEYWORDS: Homegrown Terror, Jihadi, Multiculturalism, United Kingdom, Subway Bombings, 7-7, 7-21, Airline Bomb Plot, London Bombers, Muslim Extremism, London Transit Bombing, Evolution of Jihad, Islamic Extremism, Transnational Jihad, Spread of Terrorism, Terror in the West, Bin Laden, Zawahiri, Terror and Religion, Global Jihad

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

A CASE STUDY ON THE NEED FOR AND AVAILABILITY OF PATIENT-TRACKING SYSTEMS

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Master of Science in Information Technology Management-June 2007

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This thesis analyzes the feasibility, efficiency, and usability of patient-tracking systems in support of military and humanitarian-assistance/disaster-relief operations by reviewing the implications for implementing a medical technology into the field. The initial focus of this research is on determining the need for such a system. Research discusses the strengths and weaknesses of each of the currently available systems, combining the strengths of each system into a single, "best of breed" system. This thesis also investigates the suitability of currently available commercial, off-the-shelf hardware and software components for medical operations.

KEYWORDS: Patient Tracking System, RFID, BMIST, WIISARD, TacMedCS

THE DEFENSE MESSAGING SYSTEM IN THE NAVAL, REGIONAL, ENTERPRISE-MESSAGING-SYSTEM ENVIRONMENT: EVIDENCE THAT SIZE DOES MATTER IN DEPARTMENT OF DEFENSE BUSINESS-PROCESS ENGINEERING

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Master of Science in Information Technology Management-June 2007

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Since the mandatory migration of Department-of-Defense messaging to the Defense Messaging System (DMS), implementation has been less than ideal and otherwise unsuccessful. DMS users have reported dissatisfaction with systems maintenance-and-security support burdens in the current client-server model. The Naval, Regional, Enterprise-Messaging System (NREMS) introduces a networked environment capable of push technology and centralized database and security management, which should significantly reduce the DMS shortfalls that have made the system lack appeal to the end user. As the DoD seeks to solve these issues, other potential issues are introduced that must be reviewed and addressed to ensure a successful implementation of the NREMS.

The architectural trade-off-analysis method (ATAM) and user surveys form the basis for analysis, conclusions, and recommendations. The goal of the ATAM is to understand the consequences of architectural decisions with respect to the quality attribute requirements of the system. User surveys provide the data to characterize the current naval messaging business process for each naval command and across the Navy, with the prospect of properly defining future NREMS users. Combined analysis provides a clear understanding of the alternative architecture to the existing DMS architecture.

INFORMATION TECHNOLOGY MANAGEMENT

KEYWORDS: DMS, NREMS, Messaging, BPR, Defense Message System, Navy Regional Message System, Business Process Reengineering

THE USE OF COLLABORATIVE AND THREE-DIMENSIONAL IMAGING TECHNOLOGY TO INCREASE VALUE IN THE SHIPMAIN ENVIRONMENT OF THE FLEET-MODERNIZATION PLAN

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Master of Science in Information Technology Management-June 2007

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In this thesis, phases IV and V of the current ship-maintenance (Shipmain) process are modeled, and outcomes from a reengineered process model that incorporates 3D terrestrial laser scanning and PLM technologies are predicted. The knowledge-value-added (KVA) methodology is applied to the current “as-is” environment of Shipmain to establish a baseline for comparison. A notional “to-be” environment, representing the maximum utilization of 3D-terrestrial-laser-scanning and PLM technologies, is developed and compared to the baseline environment. It is found that the potential cost savings provided by these technologies would be nearly \$78 million, a 43% reduction of current spending. Additionally, return on investment improves from 35% to 201%, which reflects the value added by the reengineered process in addition to cost savings.

KEYWORDS: Knowledge Value Added, KVA, Ship Maintenance and Modernization, Return on Investment, ROI, Return on Knowledge, ROK, Information Technology, IT, Terrestrial Laser Scanners, Collaboration, Planning Yards, Navy Shipyards, PLM, Product Lifecycle Management, Lifecycle Management, SHIPMAIN

MASTER OF SCIENCE IN LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

AN EXPLORATORY STUDY OF PERSUASIVE INFLUENCES ON MIDSHIPMAN SERVICE SELECTION AT THE UNITED STATES NAVAL ACADEMY: COMPARING SERVICE SELECTION FOR THE SUBMARINE FORCE AND THE UNITED STATES MARINE CORPS

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Master of Science in Leadership and Human Resource Development-June 2007

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The purpose of this thesis is to identify relevant characteristics associated with service choice at the United States Naval Academy (USNA). Specifically, this study compares male midshipmen from the classes of 2000-2006 who chose the U.S. Marine Corps as a first choice and those who chose the submarine force upon graduation as first choice; the predictability of these service choices is measured using appropriate independent variables. Analysis of variance and Pearson chi-square goodness-of-fit tests measure the independent variables before including them in the binary logistic regressions used to measure predictability. Data are collected from the Office of Institutional Research. This study concludes that there are differences between the midshipmen who chose the USMC and those who chose the submarine force in terms of personality, family experience, academic performance, military performance, physicality, and prior experience.

KEYWORDS: Logistic Regression, Prior Military Experience, Academic Performance, Chi-Square Test, Analysis of Variance

HOW IS THE UNITED STATES NAVAL ACADEMY DEVELOPING AND PREPARING SURFACE-WARFARE OFFICERS: A NEEDS ANALYSIS OF THE SURFACE-WARFARE- OFFICER “LEADERSHIP CAPSTONE” COURSE

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Master of Science in Leadership and Human Resource Development-June 2007

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As the United States Naval Academy (USNA) undertakes an institution-wide curriculum review, questions have been raised regarding the composition of course material and the allocation of credit hours for its first-class “leadership capstone” courses. This study analyzes the needs of the surface-warfare-officer (SWO) leadership-capstone course at USNA.

The purpose of this research is to use qualitative data to determine how the USNA SWO leadership-capstone course should be structured and to determine the appropriate balance between leadership education and practical training. The research also determines whether or not there is a gap between current course content and the expectations of commanding officers, executive officers, department heads, and division officers in the fleet, with respect to the knowledge, skills, abilities, and attitudes ensigns should possess on the day they arrive onboard their first ship. In addition to holding focus groups with course instructors and faculty coordinators, interviews are conducted with prospective commanding and executive officers, department heads, and ensigns enrolled in the division-officer’s course at the Surface Warfare Officer School Command, Newport, Rhode Island.

LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

KEYWORDS: Training and Education, Needs Assessment, Knowledge, Skills, Abilities, Attitudes, KSAA, Competencies, Surface Warfare Officers, Capstone

AN EXPLORATORY STUDY OF THE UNITED STATES NAVAL ACADEMY'S ENGINEERING CURRICULUM

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Master of Science in Leadership and Human Resource Development-June 2007

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This study quantitatively assesses Naval Academy graduates' perceptions of two aspects of their undergraduate education as engineering majors: 1) the extent to which their undergraduate education is relevant to their current profession, and 2) their level of preparedness as a result of their engineering education. The Accreditation Board of Engineering and Technology (ABET) identifies eleven "student learning outcomes" that are utilized as the basis for assessing relevance and preparedness. Baseline data is established for engineering graduates of the Naval Academy between the years 1985–2005. In addition to the general analysis, graduates are grouped for comparison and analysis according to status (civilian and military), job type (technical and non-technical), and undergraduate major. The results indicate high levels of both applicability and preparedness for most of the eleven skills. Recommendations for future engineering-program improvements are offered.

KEYWORDS: United States Naval Academy, Engineering, Accreditation, ABET, Education

MASTER OF SCIENCE IN MANAGEMENT

THE SEQUENTIAL, SELF-SELECTION AUCTION MECHANISM FOR SELECTIVE REENLISTMENT BONUSES: POTENTIAL COST SAVINGS TO THE U.S. MARINE CORPS

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This thesis explores potential cost savings for the Marine Corps by replacing the current selective reenlistment bonus (SRB) program with one that uses the format of a sequential, self-selection auction mechanism (S3AM). The power of predicting behavior based upon opportunity costs is the theoretical underpinning of the sequential, self-selection, auction mechanism. The S3AM greatly reduces the payment of economic rent. The payment of economic rent is limited because the Marine Corps would only pay Marines a monetary sum that more closely corresponds to their active-duty opportunity cost. In other words, the S3AM would allow the Marine Corps to capture more of the economic surplus, making the SRB process substantially more cost effective.

If a S3AM were used in lieu of the current SRB program, the Marine Corps would potentially save money while still meeting end-strength requirements. For example, using the S3AM in fiscal year 2006 would potentially have saved the Marine Corps \$12,123,885, \$690,471, and \$118,390, respectively, for the three military occupational specialties (MOSs) analyzed, based on a four-year multiple. This savings would have been realized if the two- and six-year S3AM model were used to pay fiscal year 2006 bonuses to the 0311s, 0621s, and 5811s that reenlisted.

KEYWORDS: Selective Reenlistment Bonuses, SRBs, Enlisted Career Force Shaping, Auctions, Personnel Auction

THE MARINE CORPS' JOINT-OFFICER MANAGEMENT POLICY AND O-7 JOINT-SERVICE-OFFICER REQUIREMENTS

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Master of Science in Management-June 2007

Advisor: William Hatch, Graduate School of Business and Public Policy

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

This study constitutes a qualitative analysis of current Marine Corps joint-officer management policy. The research is conducted at the request of Manpower and Reserve Affairs, Headquarters, U.S. Marine Corps, to review current policies and their effectiveness in supporting the requirements in the fiscal year 2005 NDAA, that all O-7 nominees be joint-service-officer (JSO) qualified prior to promotion by September 30, 2008. The Marine Corps Joint Officer Management Office, Headquarters, U.S. Marine Corps, provided all categorical data (O-4 through O-7), the majority of which represents 2006, as well as limited historical data representing 2003 to 2005. The data shows a high degree of effectiveness of the current policies, and that an increase in JPME II seats at the O-4 level would significantly increase the percentage of qualified JSOs. Currently, the number of JSO-qualified Brigadier Generals is just above 50 percent. Over the next year, the Marine Corps must reach 100 percent JSO qualification of Brigadier Generals. A follow-on study is needed to forecast O-7 continuation rates utilizing specific, career progression data to further support the fiscal year 2005 NDAA stipulation.

MANAGEMENT

KEYWORDS: Marine Corps Joint Officer Management Policy, O-7 Joint Service Officer Requirements

MANPOWER STAFFING, EMERGENCY-DEPARTMENT ACCESS, AND CONSEQUENCES TO PATIENT OUTCOMES

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Master of Science in Management-June 2007

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Pressure on emergency medical services (EMS) is rising. The growth in EMS utilization has coincided with a decline in the number of emergency departments (ED). This study has three objectives: 1) analyze trends in ED diversion (hours that hospitals have to shut down their ED and divert ambulances to other hospitals), 2) analyze the effects of ED staffing, capacity, and financial characteristics on ED diversion hours, and 3) analyze the effect of ED access on mortality rates.

For the first objective, descriptive statistics to study ED diversion trends are employed. For the second analysis, a two-part multivariate model is used to study the effect of hospital characteristics on diversion hours. For the third objective, ordinary least squares and fixed-effects models are used to determine the effect of ED access on the mortality rates of various conditions. In particular, two types of ED access are examined: diversion hours (a temporary change in ED access) and distance to closest ED (a permanent change in ED access). Hospitals in California that have to shut down their ED services temporarily (i.e., on divert status) have increased from 63% in 2002 to 75% in 2005.

Throughout 2005, EDs had to divert patients in ambulances away about 11% of the time. Several capacity and staffing characteristics influence the amount of time ED is on divert. In particular, increasing nurses and staffed beds at EDs can help curtail the hours an ED is on diversion status. Interestingly, increasing the number of intern or resident doctors in a hospital is associated with increasing hours of ED diversion.

Distance to the closest ED has either a positive (for heart-related, injury- and suicide-related, and cancer-related deaths) or insignificant (for liver-related conditions) effect on mortality rates. However, for diversion hours, it is counterintuitive that increasing diversion hours reduces mortality rates for heart-related deaths. In all cases, the magnitude of the ED access effect is extremely small, even in the case of statistically significant findings. Further study is needed to verify this result.

KEYWORDS: Manpower Staffing, Emergency Department Access, Ambulance Diversion, Patient Outcomes

MASTER OF SCIENCE IN MECHANICAL ENGINEERING

STALL-PRECURSOR DETERMINATION OF AN LM-2500 GAS TURBINE

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Master of Science in Mechanical Engineering-June 2007

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

This thesis presents an analysis of data taken from several stall-initiation events for an LM-2500 gas-turbine engine. Specifically, the time series of three separate pressure signals located at stages 3, 6, and 15 are analyzed utilizing fast Fourier transform, power spectral density, and an autocorrelation technique to determine the best and most reliable indicator to stall. The spectral analyses performed show that rotating precursor waves that travel at approximately half rotor speed are the best indicators. Several algorithms are used and it is determined that stall wave perturbations can be identified reliably about 880 revolutions prior to the stall. This work indicates that a single pressure signal located at stage three on an LM-2500 gas turbine can be used to give advance warning to a stall more than two seconds before the stall event.

KEYWORDS: Stall Precursor, Stall Detection, Compressor Stall, Stall Wave Perturbation, Gas Turbine, Fast Fourier Transform, FFT, Power Spectral Density, PSD, Autocorrelation

OSCILLATIONS OF A MULTI-STRING PENDULUM

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The mathematical pendulum is one of the most widely studied problems in engineering physics. This is, however, primarily limited to the classical pendulum with a single bar and mass configuration. Extensions to this include multi-degree-of-freedom systems, but many of the classical assumptions, such as a single bar per mass, are preserved. Several designs used in practice utilize multiple or trapezoidal configurations in order to enhance stability. Such designs have not been studied in great detail and there is a need for additional work in order to fully analyze their response characteristics. The two-string pendulum design characteristics are initially investigated, both in terms of oscillation characteristics and string tension. Analytical and numerical methodologies are applied in order to predict the response of the two-string pendulum in free and forced oscillations. Validation of the results is performed by comparisons to simulations conducted with a standard, commercial-software package. A preliminary optimization study is conducted for a driven two-string pendulum. Finally, it is shown how to apply the results of the analysis and optimization studies developed in this work in a typical design case.

KEYWORDS: Mathematical Pendulum, Multi String Pendulum, Oscillations, String Tension, Optimization

MECHANICAL ENGINEERING

HEAT-CONDUCTION ANALYSIS OF RANDOMLY DISPERSED, SINGLE-WALLED, CARBON NANOTUBES.

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This thesis studies the effective thermal conductivity of randomly oriented, percolated-carbon nanotubes. To that end, a multi-scale analysis approach is adopted. At the nanoscale, molecular dynamics simulation is performed to determine the thermal-conductivity coefficient of a single carbon nanotube. Then, thermal conductivity of two carbon nanotubes positioned at different angles is studied after determining the equilibrium positions of the two nanotubes at various relative positions. Finally, using the data obtained in the previous analyses, the effective thermal conductivity of randomly oriented carbon nanotubes is calculated using the finite element model, where each nanotube is modeled as a continuous rod.

KEYWORDS: Molecular Dynamics, Carbon Nanotubes, SWNT, CNT, Tersoff-Brenner Potential, Lennard Jones Potential

ANALYTICAL MODELING OF COMPOSITE-TO-COMPOSITE (SCARF) JOINTS IN TENSION AND COMPRESSION

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Master of Science in Mechanical Engineering-June 2007

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Fracture-mechanics-based, multi-level computational modeling and simulation techniques are developed to predict failure strengths of composite scarf joints under tension or compression. Global, local, and element-level models are used in the study to calculate the energy-release rates at the scarf joints. The study shows that explicit modeling of the resin layer at the scarf joint, where cracks initiate, is important for accurate prediction of joint-failure strengths. In addition, the consideration of the joint-interface slope in the fracture model is important, especially for compressive joint-failure strengths. In terms of the mixed-failure criteria for crack propagation, the interactive biquadratic criterion is found to be useful for reliable prediction of joint-failure strengths. The predicted strengths are in good agreement with experimental data, which are obtained for two different kinds of polymer composites, e-glass/epoxy or carbon/epoxy.

KEYWORDS: SCARF Joint, Composite, Finite Element Method, Fracture Criteria

FINITE-ELEMENT AND MOLECULAR-DYNAMICS MODELING AND SIMULATION OF THE THERMAL PROPERTIES OF NANOCOMPOSITES

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Master of Science in Mechanical Engineering-June 2007

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

This study incorporates two approaches to determine the thermal conductivity of nanocomposite material using numerical modeling and simulation. The first looks at the nanocomposite material at the macro level using a continuum model. The second approach breaks the problem down to the atomic level and addresses the inter-atomic reactions using the molecular-dynamics model.

The continuum model is used to determine the optimal placement and alignment of the nanoparticles within a nanocomposite, to provide the largest enhancement of thermal conductivity for the composite. During this process, the effects of the particle size and spacing are investigated to determine the function that interparticle spacing and particle size plays in the thermal conductivity of the composite.

The molecular-dynamics model is shown to accurately calculate the thermal conductivity of nanocomposites given the thermal conductivity of the nanoparticles and the base material.

MECHANICAL ENGINEERING

KEYWORDS: Finite Element Method, Molecular Dynamics, Nanocomposites, Thermal Conductivity

OPTIMAL TRAJECTORY GENERATION FOR MULTIPLE-ASTEROID RENDEZVOUS

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Master of Science in Mechanical Engineering-June 2007

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Second Reader: Pooya Sekhavat, Department of Mechanical and Astronautical Engineering

This thesis focuses on solving one component of the proposed problem in the global trajectory-optimization competition released by the Jet Propulsion Laboratory in late 2006. The goal is to find an optimal spacecraft trajectory to rendezvous with an asteroid in a group of asteroids. The analysis is conducted using a MATLAB application package for dynamic optimization, called DIDO. In order to verify the selection results, one-to-one transfers between earth and several asteroids are conducted. The selection process is applied to this group of asteroids. When the initial results do not meet the expectations based on the one-to-one transfers, a more thorough search for a global minimum is necessary. The gradual cost-constrained technique is used to progress from local minima toward the global minimum. The results are checked to satisfy the constraints and necessary conditions for optimality. When the results are analyzed, feasible one-to-one rendezvous trajectories are found, however, a sufficient selection process is lacking. There is a great deal of work remaining on this project, including the continued development of an asteroid selection procedure.

KEYWORDS: Optimal Control, DIDO, GTOC2, Gradual Cost-Constrained Optimization

EXPERIMENTAL INVESTIGATION OF HIGH-PRESSURE, STEAM-INDUCED STALL OF A TRANSONIC ROTOR

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Master of Science in Mechanical Engineering-June 2007

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Steam leakage from the catapult system of U.S. Navy aircraft carriers can stall the compressors of modern jet aircraft if ingested during takeoff. This phenomenon, known as “pop stall,” is of particular concern to the U.S. Navy as their current fleet of F404 engines age, the newer F414 engine comes online, and the F-35C variant of the Joint Strike Fighter begins service. The age of the F404 engine, the untested steam performance of the two stage fan in the F414 engine, and the low, serpentine intake of the F-35C make these engines and aircraft susceptible to steam-induced stall during takeoff. This study examines the high-pressure, steam-induced stall of a transonic rotor at both subsonic and transonic speeds. Steam stall is induced at 70%, 90%, and 95% of rated rotor speed, and the performance map of the rotor is re-established for 70%, 90%, 95%, and 100% of rated speed. The stall margin of the rotor and the presence of a stall precursor during both normal and steam-ingested operation are investigated. In addition, the inlet nozzle mass-flow measurements of the rig are tested against measurements in the inlet bellmouth to determine the feasibility of a shorter intake to introduce more inlet distortion into the flow.

KEYWORDS: Steam Induced Stall, Pop Stall, Transonic Rotor, Stall Margin

MECHANICAL ENGINEERING

APPLICATION OF ARTIFICIAL-BOUNDARY CONDITIONS IN SENSITIVITY-BASED UPDATING OF FINITE-ELEMENT MODELS

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Master of Science in Mechanical Engineering-June 2007

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In structural dynamics, the ability of a finite-element model (FEM) to accurately represent a structure's dynamic response (natural frequencies and mode shapes) determines its utility as a solution tool. Often the model needs to be updated or improved to better represent the structure it is modeling. An updated or improved model of an undamaged structure is often needed in order to identify damage in an in-service structure. A difficulty generally arises in trying to solve for this error because it is often represented by an underdetermined problem, as the number of parameters potentially in error in the FEM is typically much larger than the number of measured parameters. The method of artificial-boundary conditions (ABC) can help to resolve the problem and lead to an improved solution. The ABC systems provide the natural frequencies for the structure under test, under a variety of boundary conditions that are imposed computationally. Specifically, the use of ABC in sensitivity-based updating is investigated and its improvement on performance is reviewed.

KEYWORDS: Artificial Boundary Conditions, Finite Element Model, Sensitivity Based Updating

CALCULATING REQUIRED SUBSTRUCTURE DAMPING TO MEET PRESCRIBED SYSTEM DAMPING LEVELS

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Master of Science in Mechanical Engineering-June 2007

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Structural synthesis is a method of calculating the transient dynamic response of an assemblage of substructures without explicitly assembling and solving a combined system model. While significant computational advantages are provided by this method, the modal parameters of the combined system are not explicitly calculated. Hence, a method is needed to allow the *a priori* determination of the substructure damping levels such that the synthesized system damping is within user-prescribed bounds. This thesis focuses on the development of such a method.

KEYWORDS: Structural Synthesis, Lagrange Equation, Zero-Eigenvalue Theorem, Gerschgorin's Theorem, Orthogonal Complement, Lagrange Multiplier, Optimization, Substructure Damping, System Damping

REAL-TIME IMPLEMENTATION OF AN ASYNCHRONOUS VISION-BASED TARGET- TRACKING SYSTEM FOR AN UNMANNED, AERIAL VEHICLE

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Master of Science in Mechanical Engineering-June 2007

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Second Reader: Vladimir Dobrokhodov, Department of Mechanical and Astronautical Engineering

Currently, small, unmanned, aerial vehicles developed by the Naval Postgraduate School have been able to locate and track stationary and moving targets on the ground. New methods of continuous target tracking are always being developed to improve speed and accuracy, ultimately aiding the user of the system. This thesis describes one such method, utilizing an open-loop filter and an external correction source: Perspective View Nascent Technologies (PVNT). While the PVNT correction can theoretically improve the accuracy from 20–30 meters to 1–2 meters, it does have a disadvantage in that the target position updates are delayed anywhere from 1–10 seconds. In order to account for the delay, an asynchronous filter is used to update the target position data given the external position correction from PVNT. Two cases have been

MECHANICAL ENGINEERING

tested, including the general filter and one that utilizes a road model in the calculations. While an earlier thesis developed the basic simulation for the system, this thesis discusses improvements and corrections to the simulation model, as well as the necessary steps needed for real-time implementation.

KEYWORDS: Unmanned Aerial Vehicle, Asynchronous Filter, Perspective View Nascent Technologies, Vision-Based Target Tracking

THE ENHANCEMENT OF COMPOSITE SCARF-JOINT INTERFACE STRENGTH THROUGH CARBON-NANOTUBE REINFORCEMENT

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Master of Science in Mechanical Engineering-June 2007

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

Second Reader: Scott W. Bartlett, Naval Surface Warfare Center-Carderock Division

The objective of this research is to investigate the potentially significant improvement to scarf joint bonding achieved through the dispersion of carbon nanotubes along the interface of the composite joint. The study examines various factors that may affect carbon-nanotube-reinforced joint-interface strength. Each composite joint consists of a vinyl-ester matrix base, Derakane 510-A, interlaced with a carbon-fiber weave, Toray T700CF. During the curing process, the research explores several variables concerning the carbon-nanotube application. Testing includes single-walled carbon nanotubes and multi-walled carbon nanotubes with varying length, purity, and concentration levels along the surface area of the joint interface. This wide array of data demonstrates the effect the introduction of carbon nanotubes at the joint interface and provides the ideal type, size, purity level, and concentration level for composite scarf-joint bond reinforcement using carbon nanotubes.

KEYWORDS: Carbon Nanotubes, CNT, SWCNT, MWCNT, Bamboo, Polymer Composite, Joint Strength Enhancement, Reinforcement

EFFECTS OF LABORATORY ROLLING CONDITIONS ON CONTINUOUSLY CAST AA5083

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Master of Science in Mechanical Engineering-June 2007

Advisors: Terry McNelley, Department of Mechanical and Astronautical Engineering

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Quick plastic forming (QPF) is a recent adaptation of superplastic forming (SPF) that allows economical fabrication of complex components using superplastic material. QPF requires refined, equiaxed grains and high-angle grain boundaries in the microstructure to enhance sheet deformation by GBS at the high strain rates involved. This study evaluates the effects of laboratory rolling conditions on continuously cast AA5083 in the hot-band condition in anticipation of QPF. Orientation imaging microscopy, scanning electron microscopy, and X-ray analysis are used to analyze roles of the geometric dynamic recrystallization and particle stimulated nucleation of recrystallization in the microstructure evolution during rolling. A refined microstructure is developed during the rolling procedures, but mechanical property data indicate low to moderate ductility and failure by excessive cavity formation. Factors influencing the development of microstructure and mechanical properties during laboratory rolling are investigated.

KEYWORDS: Superplasticity, Superplastic Deformation, Quick Plastic Forming, AA 5083, Warm Rolling, Roll Gap Geometry, Rolling Conditions

MASTER OF SCIENCE IN METEOROLOGY

AN ASSESSMENT OF THE “WORLDWIDE MERGED-CLOUD ANALYSIS” USING INTERACTIVE GRAPHICS

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Master of Science in Meteorology-June 2007

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The Air Force Weather Agency (AFWA) uses the “worldwide merged-cloud analysis” (WWMCA) to display cloud amounts onto a hemispheric, stereographic projection map. The goal of this study is to verify the WWMCA against real-time surface-weather observations in the same spatial and temporal scale. The use of MapServer, a geographic information system tool, to make these comparisons is essential in this study. The comparisons involve ten different Air Force bases (AFB) across the U.S. continent for sixteen days. Discrepancies existed between the dry and fair climate regions as compared to more active weather regions. Nellis and Travis AFB had a higher number of verified observations compared to the other eight bases. Maxwell AFB had the highest percentage of poorly verifying observations, with 44% from the observer-only results. Overall, the WWMCA did not verify well, with a verification of 27% and a miss rate of 32%. Therefore, the AFWA needs to look at further improving cloud-model output. This study shows some of the shortcomings of WWMCA cloud-model data and the potential benefits to AFWA if improvements are made to cloud-model output.

KEYWORDS: World Wide Merge Cloud Analysis, Real-Time Surface Observation, GIS Tool

A SATELLITE-BASED FOG STUDY OF THE KOREAN PENINSULA

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Master of Science in Meteorology-June 2007

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Fog has always been a difficult phenomenon to forecast. Its unpredictable nature and propensity to quickly decrease visibilities have had adverse effects on military operations for many years across the Korean peninsula. It is particularly difficult to prepare forecasts or plan operations for remote locations with limited fog-detection ability. For detection at night, over large areas, and in remote locations, satellite observations are the best solution.

This thesis uses NASA MODIS satellite imagery to create an abbreviated climatology dataset for remote areas across the Korean peninsula. Imagery from the Terra and Aqua near-polar-orbiting satellites is used, providing four images per day: one daytime and one nighttime pass for each satellite. Two decision trees are developed to use as guidelines for fog detection by daytime and nighttime satellite images. It is not always possible to unambiguously determine if fog is in each scene, so various categories are created to supplement a fog or no fog decision. The four mid-season months (October 2005, January 2006, April 2006, and July 2006) are analyzed to create a climatology database. The results are tabulated using different variables to make useful comparisons, such as day-versus-night or Terra-versus-Aqua. The new totals are compared visually (with bar charts) and statistically to identify trends that might give insight to planners and forecasters. Seasonal and nocturnal patterns are very evident, while differences between results from the two satellites are less obvious. Future work is needed to expand the climatology and increase the statistical results from this study.

METEOROLOGY

KEYWORDS: Korea, Fog, Satellite, MODIS, Terra, Aqua, Climatology, Brightness Temperature, Irradiance, Dual Channel Difference, Snow Enhancement, Nighttime Fog Detection, Daytime Fog Detection

MASTER OF SCIENCE IN MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

A VENTURE-CAPITAL MIXED MODEL FOR THE ACQUISITION OF DEFENSE SOFTWARE PRODUCTS

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Master of Science in Modeling, Virtual Environments, and Simulation-June 2007

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

Second Reader: Theodore Lewis, Department of Computer Science

The major problem in the Department of Defense's acquisition of software systems is the growing number of cost and schedule overruns that result in failed software acquisitions. Cost and schedule overruns are the consequence of the software-development models selected, inaccurate estimation of size, time, and cost, the instability of user requirements, and poor decision-making by acquisition managers. Commercial practices of requirements definition, vendor selection, development process, business practices, integration, development, and testing, maintenance, and rights in data are compared with equivalent DoD practices. Commercial solutions are the implementation of open-source standards and architectures, iterative software developments, increased collaboration among competing vendors, and the incorporation of software reuse. The DoD's nonprofit venture-capital models utilize key practices, such as deal syndication and incremental funding, which are instrumental in managing risk and could be incorporated into how the DoD acquires software.

KEYWORDS: Software, Venture Capital, Department of Defense Acquisition System

INVESTIGATING TEAM COLLABORATION IN THE FIRE DEPARTMENT OF NEW YORK USING TRANSCRIPTS FROM SEPTEMBER 11, 2001

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Master of Science in Modeling, Virtual Environments, and Simulation-June 2007

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Anthony Kendall, Department of Information Sciences

On September 11, 2001, more than one thousand people responded to aid in rescue efforts at the World Trade Center in New York City, mobilizing the largest rescue operation in the city's history. The collaborative teamwork demonstrated in this response is recorded in the radio transcripts between responding units and the Manhattan dispatcher. The goal of this thesis is to use these transcripts to provide a real world example to validate the structural model of team collaboration, sponsored by the Office of Naval Research. This model focuses on individual cognitive processes during collaboration, with the goal of understanding how individuals work together towards making a decision. This thesis also investigates the effects of loss of situational awareness and adherence to standard operating procedure as an indicator of efficient radio communication. Efficient radio communication expedites the process of moving the team towards their ultimate goal; on September 11, 2001, that goal was to rescue the thousands of civilians trapped in the Twin Towers. This thesis uses the structural model of team collaboration to help the fire department of New York understand how it works together as a team, and offers suggested improvements as necessary.

KEYWORDS: Team Collaboration, Team Communication, Fire Department of New York, September 11, 2001

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

NAVY REQUIREMENTS FOR CONTROLLING MULTIPLE OFF-BOARD ROBOTS USING THE AUTONOMOUS, UNMANNED-VEHICLE WORKBENCH

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Master of Science Modeling, Virtual Environments and Simulation-June 2007

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Second Readers: Terry Norbraten, MOVES Institute (Modeling, Virtual Environments, and
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Jeff Weekley, MOVES Institute (Modeling, Virtual Environments, and Simulation)

The autonomous, unmanned-vehicle workbench (AUVW) is an ongoing project at the Naval Postgraduate School that allows rehearsal, real-time control, and replay of diverse autonomous unmanned vehicle (AUV) missions. The AUVW increases the situational awareness of operators while allowing operators to learn valuable insights in a robot's performance before, during, and after a mission.

This thesis examines a variety of strategic authoritative plans for autonomous vehicles to determine functional mission requirements that autonomous vehicles are expected to be performing in the near future. Excellent agreement on tactical needs and requirements is found among these diverse documents. A series of exemplar missions corresponding to specific requirements are presented as a way to explore and evaluate different tactical capabilities. These missions are then compared to the current capabilities of the AUVW by planning, running, and evaluating them in the workbench. Although the AUVW is a powerful tool, it still lacks some functionality to make it tactically usable. Nevertheless, perhaps two thirds of the necessary capabilities are already supported in the workbench and further capabilities can be feasibly integrated. The result of this work is a roadmap for future work to add functionality so that the workbench can thoroughly perform user tasks in all mission areas.

KEYWORDS: AUV, UUV, USV, UAV, Robotics, Autonomy, XML, XSLT

AN ANALYSIS OF LEARNING ALGORITHMS IN COMPLEX STOCHASTIC ENVIRONMENTS

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Master of Science in Modeling, Virtual Environments, and Simulation-June 2007

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Simulation)

With the military continuing to increasingly utilize intelligent agents in a variety of operational aspects, event prediction and learning algorithms are becoming more and more important. In this paper, a detailed analysis of two such algorithms, variable-order Markov and look-up table models, is conducted. Each model employs different parameters for prediction, and this study attempts to determine which model is more accurate in its prediction and why. The study finds that the models contrast in that the variable-order Markov model increases its average prediction probability, the primary performance measure, with increased maximum model order, while the look-up table model decreases average prediction probability with increased recency time threshold. In addition, statistical tests of results of each model indicate a consistency in each model's prediction capabilities, and most of the variation in the results could be explained by model parameters.

KEYWORDS: Event Prediction, Learning Algorithms, Agents, Markov Models

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

A DYNAMIC, THREE-DIMENSIONAL, NETWORK-VISUALIZATION PROGRAM FOR INTEGRATION INTO CYBERCIEGE AND OTHER NETWORK-VISUALIZATION SCENARIOS

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Master of Science in Modeling, Virtual Environments, and Simulation-June 2007

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Master of Science in Modeling, Virtual Environments, and Simulation-June 2007

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Second Reader: Michael Thompson, DoD Contractor

To better secure computer networks, obtaining detailed information and intellectual understanding of a network's topology and vulnerabilities is invaluable. To provide more information, network-protocol analyzers and intrusion-detection systems are utilized. Additionally, game-based trainers, such as CyberCIEGE, have been shown to improve the level of training and understanding provided to network security professionals. This goal of this thesis is to enhance these applications by developing the "Network Topology and Attack Visualizer (Three Dimensional)" (NTAV3D).

The result of NTAV3D development is a tool that displays network topology, vulnerabilities, and attacks in an interactive, three-dimensional environment. This successfully augments the engaging design and gameplay of CyberCIEGE by increasing gameplayer interaction and improving data display. Additionally, NTAV3D can be expanded to provide this capability to network analysis and intrusion detection tools. Furthermore, NTAV3D is designed by incorporating conclusions from previous research on the best ways to visualize network topology, vulnerabilities, and attacks, and thus serves to expand these ideas.

NTAV3D is created using open-source software technologies, including Xj3D, Java, and XML. It is also one of the first applications to be created using only the Xj3D toolkit. Therefore, the development process allows evaluation of these technologies, resulting in recommendations for future improvements.

KEYWORDS: Network Visualization, Networking, Networks, CyberCIEGE, Network Security, Intrusion Detection Systems, Extensible Markup Language, XML, Java, Xj3D, X3D

EXTENSIBLE 3D (X3D) GRAPHICS FOR VISUALIZING MARINE-MAMMAL REACTION TO UNDERWATER SOUND ON THE SOUTHERN CALIFORNIA ASW RANGE (SOAR)

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Master of Science in Modeling, Virtual Environments, and Simulation-June 2007

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Curtis Collins, Department of Oceanography

John Joseph, Department of Oceanography

U.S. Navy use of sonar is essential for national defense, but its potential impacts on marine mammals are not well understood. Predictive models have been developed, but the need still exists for modeling actual marine-mammal reaction during Navy exercises.

The goal of this thesis is to develop a tool that can assimilate data collected from on-range exercises for visualizing and quantifying marine-mammal reactions to underwater sound. In this thesis, X3D Graphics is used to model an acoustic source and visualize acoustic and GPS tracking data collected during exercises. Generating geo-referenced, time-synchronized 3D displays of an August 2006 test, marine-mammal positions and tracks of two research boats are visualized over realistic bathymetry. In a separate August 2004 experiment, acoustic transmissions and tracking of a training target are modeled. These demonstrate the essential components needed for visualization of marine-mammal reactions during an ASW exercise.

Potential future work includes utilizing this system to model multiple SOAR exercises, which will provide baseline data analyses to better understand mammal vulnerabilities and improve Navy mitigation.

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

KEYWORDS: 3D Visualization, Marine Mammals, Southern California ASW Range, ASW, SOAR, X3D Graphics, San Clemente Island, Southern California Offshore Range, SCORE, Marine Mammal Protection Act of 1972

MASTER OF SCIENCE IN OPERATIONS RESEARCH

AN INTEGER LINEAR PROGRAM TO COMBINE CONTAINER HANDLING AND YARD- CRANE DEPLOYMENT

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Master of Science in Operations Research-June 2007

Advisor: Robert F. Dell, Department of Operations Research

Second Reader: Johannes O. Royset, Department of Operations Research

The number of containers handled by container terminals has increased significantly over the last fifty years and has stimulated researchers to improve storage-yard operations. Container handling and crane deployment are two major yard operations that can impact the performance of a whole container terminal. This thesis establishes an integer linear program (ILP) to combine container handling and yard-crane deployment for rubber-tired gantry cranes (RTG). Using real data, the ILP for two different yard sizes is tested. The resulting ILPs are difficult to solve directly. In order to decrease the computation time and satisfy memory requirement, a cascade method that solves the problem as a sequence of restricted sub-problems is applied. Each sub-problem is restricted to a sequence of containers and the output of each sub-problem provides an input to the next sub-problem. This method provides better solutions than the solution derived by solving the problem directly. The cascade method also decreases the computation time significantly. The results demonstrate the ability to combine container handling and yard-crane deployment in a single model, and they verify that the cascade method works well with the ILP.

KEYWORDS: Optimization, Linear Integer Programming, Container Terminal, Yard Management Strategies, Crane Deployment

AN EXAMINATION OF THE ARMED FORCES' CLASSIFICATION TEST AND ITS USE AS A FORCE-SHAPING TOOL

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Master of Science in Operations Research-June 2007

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

In an attempt to balance the manning of the United States Navy, the "Perform to Serve" program was instituted. As a part of this program, sailors are encouraged, and often required, to retake the armed-services vocational-aptitude battery, called the Armed Forces Classification Test (AFCT), after enlistment, in the hope that they will then qualify for more occupations.

This study examines the aspects that are associated with success or failure on the second exam for thirty-five occupational qualifications. Predictive models are created for the different occupational categories using these observations, with as many as six predictor variables for each model. One of the predictor variables that occurs in many of the models is the time between the administration of the two exams. Over 500 observations are examined and it is shown that there are increases in qualification for all occupations.

KEYWORDS: Armed Forces Classification Test, AFCT, Force Shaping

OPERATIONS RESEARCH

DESIGN OF EXPERIMENT AND ANALYSIS FOR THE JOINT DYNAMIC ALLOCATION OF FIRES AND SENSORS SIMULATION

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M.S., New School University, 1998

Master of Science in Operations Research-June 2007

Advisor: Thomas W. Lucas, Department of Operations Research

Second Reader: LTC Darryl K. Ahner, USA, U.S. Army, TRADOC Analysis Center-Monterey

The U.S. Army Training and Doctrine Command (TRADOC) Analysis Center's Joint Dynamic Allocation of Fires and Sensors (JDAFS) model, a low-resolution, discrete-event simulation model with embedded optimization, enables the analysis of many scenarios and factors to explore joint intelligence, surveillance, and reconnaissance (ISR) missions. JDAFS is a powerful model that combines both discrete event simulation and the optimization of a linear objective function to generate realistic, reasonable, and consistent solutions to difficult ISR scheduling problems. Given a scenario and a mix of ISR platforms, JDAFS optimizes a flight schedule and executes the missions. This research develops a joint ISR scenario, explores scenario simulation results, and provides a proof-of-principle analysis that aids in the ISR decision-making process.

This study examines 274 design points in each of two scenarios, a non-penetrating scenario that allows only standoff collection and a penetrating scenario that allows country of interest overflight. The use of an efficient design of experiment methodology enables the exploration of the interior and exterior of the response surface for the two experimental scenarios. Analysis of the simulation output suggests that the optimization interval significantly impacts total coverage. In the non-penetrating scenario, shorter optimization intervals ensure better coverage; however, in the penetrating scenario, longer optimization intervals provide for improved coverage. The disparity is explained by reduced likelihood of assignment saturation in the penetrating scenario due to the increased number of mission areas. Sensor range, sensor package configuration, and platform dwell time also affect the level of coverage. This is clearly demonstrated by the superior coverage provided by the most capable ISR platforms.

KEYWORDS: Joint Dynamic Allocation of Fires and Sensors, JDAFS, Assignment Scheduling Capability for UAVs, ASC-U, Intelligence, Surveillance, Reconnaissance, ISR, Design of Experiment, DOE, Simulation Analysis

TEST AND EVALUATION OF THE MICRO-OBSERVER SENSOR SYSTEM FOR USE AS A SEISMIC-SURVEILLANCE DEVICE IN AN INTEGRATED SENSOR NETWORK

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Master of Science in Operations Research-June 2007

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Gurminder Singh, Department of Computer Science

This thesis investigates the feasibility of deploying unattended, seismic ground sensors in an operational environment to provide persistent surveillance and early warning detection capabilities. The system employed is the commercially available MicroObserver sensor system.

A robust testing and evaluation plan is created to measure the system's objective performance, based on specific criteria. The tests focus on the capabilities of the sensor system across a broad range of deployment environments. Tests are conducted to determine probabilities of detection, battery life, and operational effectiveness. Prediction models of the system's ability to detect targets are also created to assist planners in assessing the utility of MicroObserver in specific operations. Although the sensing capabilities satisfy the established metrics, the sensor system possesses inherent limitations inhibiting its adequacy for use in many military operations. However, the sensor network would work well in many security applications where sensor-system weaknesses could be anticipated and mitigated.

KEYWORDS: Unattended Ground Sensors, Surveillance, Metrics, Networking, Test and Evaluation, MicroObserver Sensor System, Seismic Sensors

OPERATIONS RESEARCH

THE TOTAL-ARMY COMPETITIVE CATEGORY OPTIMIZATION MODEL: ANALYSIS OF U.S. ARMY OFFICER ACCESSIONS AND PROMOTIONS

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Master of Science in Operations Research-June 2007

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LTC Paul L. Ewing, USA, Department of Operations Research

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

The U.S. Army's mission is to protect the nation and fight its wars; a mission that requires a substantial resource commitment. The Army today consists of over 505,000 soldiers (more than any other U.S. military service), with over 81,000 of those soldiers in the officer corps. This thesis develops a linear program to help manage the Army competitive category (ACC), a subset of the officer corps consisting of over 51,000 soldiers. The "Total-Army Competitive-Category Optimization Model" (TACCOM) prescribes annual accessions and above zone, primary zone, and below zone promotion rates for all grades from lieutenant to colonel over a forty-year horizon. The TACCOM is demonstrated using data from fiscal year 2006 and requirement information for all officers in the ACC, and also for the subset of officers just in the aviation (AV) branch. A deficit is found at the grade of major, which will continue to exist through fiscal year 2021 if current policy is not changed. The analysis on just the AV branch shows their mid-grade officer shortage can be remedied by either increasing training capacity by two-thirds or reducing the attrition of captains who have five years' time in grade. This analysis also shows the current ACC accessions plan and promotion policies remedy the shortages at the grade of major for the next seven years, but that there are future shortages ahead. Using TACCOM, it is found that one way to reduce the magnitude of the future shortfalls is to adjust the current promotion policy by increasing the number of early promotions to major. By accelerating the promotion to major in the ACC, the Army is facing a shortage of majors for only four years, from fiscal year 2013 through 2017, versus the seven-year shortage without a policy change.

KEYWORDS: Manpower Planning, Optimization, Army Transformation

MODELING INSURGENCY ATTRITION AND POPULATION INFLUENCE IN IRREGULAR WARFARE

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Master of Science in Operations Research-June 2007

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Second Reader: COL Alejandro Hernandez, USA, Department of Operations Research

A model is developed that is a combination of Lanchester and Deitchman attrition models and population epidemic models. Based on different attrition, recruitment, and transition rules, the relationships between dynamic population flow and insurgency success or failure are studied. The goal of this work is to provide an analytical framework for these situations and to analyze the effect of different initial conditions and interactions on the success or failure of an insurgency. The models developed herein are descriptive, not predictive, and are designed to give decision makers an insight into a complex insurgency process.

KEYWORDS: Irregular Warfare, Difference Equations, Epidemiology Models

OPERATIONS RESEARCH

CONFLICT RESOLUTION AND OPTIMIZATION OF MULTIPLE-SATELLITE SYSTEMS

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Master of Science in Operations Research-June 2007

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I. Michael Ross, Department of Mechanical and Astronautical Engineering

Second Reader: Wei Kang, Department of Applied Mathematics

This thesis produces models of satellite constellations using finite-state automata (FSA) or finite automata (FA) and optimizes the sequence of targets for two missions. Two simplified FSA models of satellite constellations with one ground-control station are developed. The first model is of a single spacecraft and the second, of two spacecraft. Based upon the language, states, and state transitions of each model, the FA is transformed into a network and the shortest paths for indicative lists of meta-tasks from each model are enumerated. The first model is provisionally implemented in MATLAB. Two separate optimal-target-selection sequences for randomly generated sample target sets using commercial, off-the-shelf optimization software are found. Although stochastically fabricated, the sample target sets reflect valid scenarios for a satellite imagery mission. The first sequence, a traveling-salesman problem, minimizes the time required for processing all targets given a multiple orbit mission. For a representative sample target set, this is 2.34 orbits. The second sequence, a prize-collecting traveling-salesman problem, maximizes the number of targets processed given a dual-orbit mission. For the same sample target set, two orbits permit the processing of seven targets.

KEYWORDS: Satellite, Optimization, Finite Automata, Finite State Automata, Finite State Machine

EXPLORING NAVAL TACTICS WITH UNMANNED AERIAL VEHICLES IN AN ISLAND COMPLEX USING AGENT-BASED SIMULATION

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Hellenic Naval Academy, 1993

Master of Science in Operations Research-June 2007

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Second Reader: Kyle Y. Lin, Department of Operations Research

The benefits of unmanned aerial vehicles (UAV) at sea are undisputed. The amount and speed of incoming information from a UAV, combined with its maneuverability and “time-on-task” capability, are assets to any navy. For the Greek navy, the main local operation area consists of the Aegean and Ionian seas. Because Greece lies between three continents (Europe, Asia, and Africa), there is a great deal of sea traffic and much potential for illegal activities, such as smuggling, exploitation of illegal immigrants, and possible terrorist activity. The goal of this study is to explore naval tactics with UAVs in an island complex using agent-based simulation. Map-aware, non-uniform automata (MANA) software, used in this study, provides a visual and realistic background to conduct simulations of real operations involving many different entities. This thesis demonstrates that this type of software can rapidly produce, explore, and check simulated naval tactics before actual implementation. It also shows how the UAV’s technology plays a key role in a search-and-detection operation, whereas the enemy must rely mostly on his tactics.

KEYWORDS: UAV, VTUAV, Naval Tactics, Fast Patrol Boat Tactics, Search and Detection, MANA, Agent-Based Simulation, Design of Experiment, Data Farming

OPERATIONS RESEARCH

HISTORICAL REVIEW OF COST PERFORMANCE INDEX STABILITY

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Daniel A. Nussbaum, Department of Operations Research

Second Reader: Steven R. Miller, DoD Contractor

The focus of this study is to determine when the cumulative cost-performance index (CPIcum) stabilizes for different contract characteristics. The CPI is the relationship between the budgeted costs for work performed divided by the actual costs of work performed. Once the CPIcum stabilizes, program managers and analysts are able to use this index as a predictor in estimating the final cost of the contract. The range method and the narrowing interval method are used to test for CPIcum stability at the 50% complete point. For the range method, stability is declared if the range, which is the maximum CPIcum value minus the minimum CPIcum value over a specified interval, is less than or equal to .20. The results for the range method indicate that the CPIcum is stable at the 50% complete point. Further analysis shows that the CPIcum is stable as early as the 10% to 20% complete point. For the narrowing interval method, stability is declared when the variance of the CPIcum is less than or equal to plus or minus .10 over a specified percent complete interval. The results for this method indicate that the CPIcum could only be declared stable from the 50% complete point.

KEYWORDS: Earned Value Management, Cost Performance Index, Cost Analysis, Cost Performance, Contractor Performance, Range Method, Narrowing Interval Method

AN ALTERNATIVE OPTIMIZATION MODEL AND ROBUST EXPERIMENTAL DESIGN FOR THE ASSIGNMENT-SCHEDULING CAPABILITY FOR UNMANNED AERIAL VEHICLES (ASC-U) SIMULATION

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Second Reader: LTC Darryl K. Ahner, USA, U.S. Army, TRADOC Analysis Center-Monterey

This thesis presents an alternative optimization model, explores 23 simulation factors, and provides sensitivity analysis for how unmanned, aerial vehicle (UAV) coverage may degrade in the presence of adverse random events. Integer programming, design of experiments, and an innovative optimized, flexible, Latin hypercube (OFLH) design are used to evaluate a representative sample from an Army 2018 scenario. The conclusions suggest the following: the alternative optimization model developed in this thesis can successfully maximize ASC-U total value without the use of a heuristic; incrementally smaller Optimization Intervals do not guarantee higher total value when the heuristics are included; to maximize total value, the Early Return heuristic should be set to false, the secondary-areas heuristic should be set to true, and the appended-areas heuristic should be set to true; an OFLH design is valuable for robust analysis of simulation models containing many factors; and, as the simulation factors change over predefined ranges, the ASC-U solution quality is consistent.

KEYWORDS: Integer Programming, Latin Hypercube Designs, Design of Experiments, Linear Regression Models, Simulation Analysis, Unmanned Aerial Vehicles, Discrete Event Simulation, Future Combat Systems, UAV, Optimization, Optimized Flexible Latin Hypercubes, Nearly Orthogonal Latin Hypercubes, Stochastic Interactive Simulation

OPERATIONS RESEARCH

SAMPLE-SIZE DETERMINATION FOR ESTIMATION OF SENSOR DETECTION PROBABILITIES BASED ON A TEST VARIABLE

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Master of Science in Operations Research-June 2007

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

In this thesis, procedures and required sample sizes for estimating the probability of detection as a function of range to target for sensor systems, as evaluated by the U.S. Army's Yuma proving ground, are studied. First, the problem is examined within the context of a binomial experiment to improve the current estimation method used by Yuma. Specifically, the coverage probabilities and lengths of widely used confidence intervals for a binomial proportion are evaluated and the required sample sizes for some specified goals are reported. Although the required sample sizes turn out to be impracticably large, this research provides the proving ground with a better understanding of the usual confidence intervals and variability inherent in their current estimation scheme. Second, it is shown that confidence intervals for a probability of detection as a function of range based on the fit of a simple linear, logistic-regression model perform much better than the usual confidence intervals for a binomial proportion. Using an empirical approach based on a controlled set of simulations, the required sample size within the experimental region of interest is determined.

KEYWORDS: Sample Size, Binomial Proportion, Confidence Interval, Coverage Probability, Experimental Design, Logistic Regression

ANALYSIS OF INTERACTIONS OF LOGISTICS ELEMENTS OF K-1 TRACKED VEHICLES IN THE REPUBLIC OF KOREAN ARMY BY USING SIMULATION MODEL

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The K-1 tracked vehicle (K-1 TV) has been the main battle tank of the Republic of Korean Army (ROKA) for the last twenty years. Maintaining the highest level of combat readiness of the K-1 TV is one of the most critical missions for ROKA logisticians. This research focuses on the improvement of depot-level maintenance (DLM), since it has considerable influence over the combat readiness of the K-1 TV.

A simulation model of the DLM process is built. Four major logistics elements are the input parameters: component failure rate, repair rate, inventory service level, and logistics delays. The model (with these logistics elements) is simulated for acquiring data; results provide guidance about the interactions of logistics elements.

Analysis of the results shows the effective procedures and significant elements during DLM of the K-1 TV. In conclusion, the procedures of the analysis provide valuable insights related to the methodologies of analysis of the logistics elements, and facilitate logisticians in conducting efficient logistics support.

KEYWORDS: K-1 Tracked Vehicle, Depot Level Maintenance, Nearly Orthogonal Latin Hypercube, Design of Experiment, Robustness Readiness, Multiple Regression Analysis, Integrated Logistics Support, Component Failure Rate, Repair Rate, Inventory Service Level, Logistics Delay

OPERATIONS RESEARCH

DATA-MINING THE ARMY RESERVE FOR ANALYSIS OF ATTRITION FACTORS

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The goal of this thesis is to analyze the impact of increased utilization and deployments of troop program unit (TPU) soldiers since 9/11, countered against the effects of demographics and the programs and actions meant to control attrition.

This study conducts a process of data collection, data manipulation, and data-mining algorithms executed against the entire enlisted TPU population, with a focus on attrition behavior.

Significant factors in determining attrition behavior include time in service, increased bonus levels, and the delayed-entry program. Mobilizations, in and of themselves, appear to have little impact. The models built show significant potential for predicting behavior. This process should be continued and expanded to a tool to aid in and affect attrition.

KEYWORDS: USAR, Manpower Modeling, Enlisted Modeling, Army Reserve, Military Manpower Modeling, Data Mining, Attrition

U.S. CHEMICAL-WARFARE STOCKPILE VULNERABILITY: EFFECTS TO LOCAL INFRASTRUCTURE FROM A CHEMICAL-AGENT RELEASE

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This thesis develops methods to identify certain infrastructure vulnerabilities from the accidental or intentional release of a chemical agent from a U.S. chemical-warfare stockpile or facility (CF). For the region surrounding any CF, a “multi-infrastructure network-operations model” (MINO) is created from various infrastructure datasets: MINO covers the local population, road network, and emergency-response systems. Standard software generates a chemical-agent release scenario that requires the evacuation of part of the region, and that blocks emergency responders from using certain roads. Using shortest-path methods, one version of MINO then identifies evacuation routes that the local population will likely use, showing where traffic congestion may slow evacuation. Another version computes and compares emergency-response distances, pre-release and post-release, for areas outside the contaminated region. Two or three scenarios are examined for each of six CFs. In the areas surrounding Newport, Indiana, and Pueblo, Colorado, CFs show low evacuation numbers and low traffic intensities. For the Anniston, Alabama; Blue Grass, Kentucky; and Umatilla, Oregon CFs, several roads exhibit high traffic intensities that may slow evacuations. Several of these scenarios, along with one Pueblo incident, also show significant travel-distance increases for emergency responders. Software limitations prohibit analysis of the CF at Tooele, Utah.

KEYWORDS: Chemical Facility, Chemical Agent, Chemical Release, Evacuation, Emergency Response, Infrastructure, Road Network, Shortest Paths, Graphical-Information System

OPERATIONS RESEARCH

EASTERN NORTH CAROLINA MARINE CORPS FORCES AND INSTALLATIONS' HIGH-INTENSITY HURRICANE EVACUATION-DECISION SUPPORT

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Eastern North Carolina Marine Corps Forces and Installations (ENCMCFI) is located on the Atlantic coast of North Carolina and is therefore vulnerable to a major hurricane. Base commanders must weigh the substantial costs of evacuation—approximately \$30-\$50M for a full evacuation—against the risk posed by the storm if personnel are not evacuated. The purpose of this thesis is to provide a decision aid for base commanders to identify forecast conditions that indicate the need to initiate evacuation. In order to assess the probability of a direct strike to ENCMCFI posed by a new storm, this thesis proposes using National Hurricane Center forecasts combined with a statistical model of historical forecast errors. Additionally, an analysis of available evacuation assets and the distances to primary evacuation locations is conducted to identify available options for evacuation at the decision time. A series of decision rules is created to determine whether, based on the current storm forecast and the available evacuation assets, evacuation is warranted instantly or whether it is better to wait until the next forecast is issued. The results of this study indicate that the risk of riding out the storm at ENCMCFI and the transportation risk of evacuating are approximately equal given the current evacuation plan and the required lead time.

KEYWORDS: Marine Corps Hurricane Evacuation

SYSTEM-OF-SYSTEMS TEST PLANNING IN A COMPLEX, JOINT ENVIRONMENT

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Force transformation requires much emphasis on testing joint warfighting capabilities. A unique challenge in assessing the effectiveness and suitability of systems in the joint environment is the multitude of possible interactions and outcomes in a system-of-systems construct. Because of resource constraints and the complexity of conducting live, virtual, and constructive testing in a joint-mission environment, the Joint Test and Evaluation Methodology (JTEM) program is interested in determining if analytical techniques, like modeling and simulation, can be applied to understand the relationship between system-of-systems performance and joint-mission effectiveness. As a proof of concept, a network-enabled weapon (NEW) is chosen as a framework for this study. This thesis uses an agent-based distillation, which is a type of computer simulation, to model the critical factors of interest in a NEW engagement without explicitly modeling all the physical details. Using cutting-edge experimental design techniques, the computer model is run tens of thousands of times and the results are analyzed to determine the critical parameters required for mission success. The analysis determines key interactions in NEW system performance and provides JTEM with a framework for efficiently conducting testing in a live environment. Specifically, the results indicate sensor range of a third-party ground controller, target speed, NEW impact radius, and weapon accuracy as the key factors affecting system performance.

KEYWORDS: Joint Test and Evaluation, JTEM, Experimental Design, Agent-Based Modeling and Simulation, Network Enabled Weapons, Nearly Orthogonal Latin Hypercubes

MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

DIRECTIONAL CHARACTERISTICS OF INNER-SHELF INTERNAL WAVES

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Internal tidal-bore events observed at a Monterey Bay inner-shelf site are analyzed. A six-month data set from the Naval Postgraduate School's Monterey Inner-Shelf Observatory (MISO) site included water-column current velocities and thermal-structure data. Isothermal displacements paired with concurrent velocity observations in the water column are used to assess the events' individual characteristics as the internal tidal bores shoal and approach the surf zone. The primary hypothesis tested is that if the internal tidal bores observed at MISO had strong along-shore current velocity signatures, then those bores were most likely generated at the Monterey Bay submarine-canyon edge or were evidence of an internal edge wave. If velocity signatures were primarily cross-shore, then bores would most likely propagate from straight across the shelf westward from their generation site at the continental shelf break. Visual observations of temperature profiles, current vector plots, linear regressions, and histograms are employed to test the relationships between forcing, stratification, and internal tidal bore forms. The unique aspect of this research is the focus on shoaling effects of internal tidal bores after they have traversed the continental shelf and impinge on the nearshore. Additionally, coastlines with significant bathymetric features, like Monterey Bay, are of operational interest to the military and are prime generation sites for these internal bore and soliton events. Internal tidal bores can directly impact naval special operations; specifically, amphibious landings and SEAL delivery vehicle operations. Understanding where and how bore and soliton events are generated is beneficial to nearshore modelers and operators.

KEYWORDS: Internal Tidal Bore, Soliton, Solibore

THE VALUE OF NUMERICAL FORECAST PRODUCTS IN IMPROVING TACTICAL AIR-DELIVERY METHODS

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This thesis develops an agent-based system to analyze meteorological model data and generate statistics for comparison purposes. With this system, it is possible to research the value and level of improvement when utilizing different levels of atmospheric-model resolution for guidance in tactical decision aids. This agent-based system automates the comparison of model data at a location in the model field with environmental data extracted from sensor data obtained from radiosonde launches. Statistics are efficiently generated for the variability of the u and v components of the wind directions, to aid in the rapid determination of the variability of model data and its effects on targeting accuracy. By addressing the interoperability and adaptability of agents, this research demonstrates the usefulness of agents to extract information to rapidly compute mission-planning accuracy.

KEYWORDS: Numerical Modeling, Agent Based System, Model Resolution, Improved Accuracy, Tactical Data Application, Automated Analysis, Data Mining

PHYSICAL OCEANOGRAPHY

THE CONSEQUENCES OF WIND FORCING ON OCEAN CIRCULATION OVER THE CONTINENTAL SHELF NORTH OF THE MONTEREY BAY

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In August 2006 an adaptive sampling and prediction (ASAP) experiment was conducted near northern Monterey Bay. Multiple assets, including aircraft, autonomous vehicles, moorings, and numerical models were used to gain a better understanding of three-dimensional upwelling centers. Data were collected at two mooring locations using acoustic-doppler current profilers (ADCP) during the experiment. The focus of this thesis is to determine the effects of local wind forcing on the ocean circulation and to provide a comparison between the data collected at the mooring locations and numerical predictions for the region. Upwelling and relaxation events are used as the basis for understanding the local wind forcing. Upwelling typically results in equator-ward flow while relaxation events typically result in pole-ward flow. Several different types of analyses were used to determine the effects of the local wind forcing. A visual analysis was performed with stick vector plots and component plots of the rotated time series that compared the wind with the data from the water column. Two methods of cross correlation, component correlations and vector correlations, were exploited, as well as a spectral analysis of the wind and ADCP data. Finally the coherence and phase between the wind and currents were examined. Based on the analysis it became evident that the currents were forced by both wind and non-local events such as eddies, meanders, and the large-scale along-shelf pressure gradient.

Associated with the ASAP experiment, the Harvard Ocean Prediction System, the Regional Oceanic Modeling System, and the Navy Coastal Oceanic Model provided now-casts that were compared with the mooring data to determine their accuracy and precision. Overall, in the beginning of August the models provided reasonable representations of the flow patterns at the mooring locations. The prediction error increased towards the end of August, which was possibly related to data-assimilation techniques and more non-local forcing at that time. The military application of this thesis is that accurate current prediction by ocean models will benefit amphibious operations, special warfare operations, and mine warfare in the littoral zone.

KEYWORDS: Monterey Bay, Adaptive Sampling and Prediction Experiment, ASAP Experiment, Wind Forcing, Numerical Modeling

MASTER OF SCIENCE IN PHYSICS

RADAR TARGET RECOGNITION USING BISPECTRUM CORRELATION

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Ship commanders and pilots make life-or-death decisions based on the information at their disposal at the instant a decision is made. One component of that information is whether a radar contact is an enemy or friend. Various systems try to answer that question based on the characteristics of signals emitted or scattered from the contact. The goal is to maximize the accuracy of identification in order to build trust that when the system tells the operator the contact is an incoming friendly, he knows that it is.

This thesis examines the technique of using the bispectrum of backscattered radar energy to identify a contact. Bispectra allow the examination of multiple scattering contributions to the return. This technique is compared to one using radar range profiles. A library of sample radar signatures is built using computational radar cross-section estimation tools and 3D model aircraft. This library is the basis of a series of simulations with aircraft at multiple aspects and configurations to determine whether using the bispectrum enhances the performance of identification systems using range profiles. It is determined that a bispectrum method meets or exceeds the identification accuracy of a range profile method especially with high-bandwidth systems.

KEYWORDS: Bispectrum, Non-Cooperative Target Recognition Techniques, NCTR Techniques, Range Profile, Contact Identification

DEPLOYMENT OF SHAPED CHARGES BY A SEMI-AUTONOMOUS GROUND VEHICLE

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Neutralization of remotely operated improvised, explosive devices (IEDs) is a dangerous task, risking human lives daily. BigFoot seeks to replace the local human component by deploying and remotely detonating shaped charges to destroy IEDs. This research develops a platform that can autonomously navigate GPS waypoints, avoid obstacles, and provide remote controls for an onboard robotic arm to deploy and remotely detonate shaped charges. BigFoot incorporates improved communication range over previous autonomous ground vehicles and an updated user interface that includes controls for the arm and camera by interfacing multiple microprocessors. BigFoot is capable of avoiding static and mobile obstacles, as well as handling most surfaces with minor slopes. BigFoot continues to be somewhat limited by communications range and GPS availability. However, BigFoot is an ideal platform for relatively short-range deployment to neutralize roadside IEDs.

KEYWORDS: Autonomous, Robot, Shaped Charge, Improvised Explosive Device, IED

PHYSICS

LAGUERRE-GAUSSIAN MODES IN THE FREE-ELECTRON LASER

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In a free-electron laser (FEL) system, knowing optical-beam characteristics is of great importance. A beam may be comprised of higher-order modes due to the interaction with the electron beam, or from non-ideal operational conditions (such as mirror distortions and misalignments) or imperfect injection of the electron beam.

In this thesis, basic FEL theory is initially reviewed. The parabolic wave equation is then solved for the fundamental Gaussian mode and for higher-order modes. Working in rectangular coordinates, a complete and orthogonal set of solutions involving Hermite polynomials is found. When the wave equation is solved in cylindrical coordinates, a set of solutions that contain Laguerre polynomials is derived. The so-called Laguerre-Gaussian modes are analyzed. The evolution of these laser modes is also explored, yielding quite unexpected results due to their phase structure and orbital angular momentum of light. Finally, a common case where higher-order optical modes appear is studied to quantify the tolerances of an FEL.

KEYWORDS: Free Electron Laser, High-Order Modes, Laguerre-Gaussian Optical Modes

TRIGGERED, INFRARED-EMITTER DISPLAYS FOR INDIVIDUAL IDENTIFY-FRIEND-OR-FOE AND VEHICLE-MOUNTED IDENTIFY-FRIEND-OR-FOE DEVICES

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Individual identify-friend-or-foe (IFF) devices, based on polymer emitters on flexible substrates, are evaluated to determine range of activation and observation, performance under extreme environmental conditions, and emitter-intensity decay as a function of multiple activations and time. Key results include observation at distances in excess of 700 meters and device functionality in a temperature range from -40 0C to 71 0C.

From data obtained in the development and testing of the individual anti-fratricide devices, a vehicular version is developed with the purpose of mitigating air-to-ground fratricide. A rudimentary prototype is developed and tested, followed by an improved, more powerful version. Field tests include establishing limits for activation and observability. Finally, the emission is captured and graphically represented as a function of time. Key results include observation at distances in excess of 9.5 km and demonstration of remote activation.

An area for further research using quantum-dots down conversion is offered. Quantum-dots down conversion could be used for wavelength tuning of the polymer, organic-light-emitting material.

KEYWORDS: Anti-Fratricide, Polymer Organic Light Emitting Display, P-OLED, Individual Identify Friend-or-Foe, IIFF, Vehicular Mounted Identify Friend-or-Foe, VMIFF, Night Vision Device, NVD

MASTER OF SCIENCE IN PROGRAM MANAGEMENT

ORGANIZATIONAL STRATEGIC PLANNING AND EXECUTION: SHOULD GOVERNMENTAL ORGANIZATIONS RELY ON STRATEGIC PLANNING FOR THE SUCCESS OF THE ORGANIZATION?

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Strategic planning is employed by governmental and private organizations as a standard practice for improving an organization's overall performance. A plethora of studies indicate that the effectiveness of the strategic planning-and-execution process in private industry is questionable in many cases, and for various reasons. While at times the utilization of this tool yields positive results in many companies and organizations of various sizes and types, many other times the strategic plan is not utilized and becomes a costly paperweight on a table in the executive suite. Nonetheless, government agencies have embraced the private sector's ideology of employing the strategic plan and have plowed headlong into the use of this methodology. The goal is to provide the organization with a tool that could help change or improve the direction of the organization. This project examines the implementation of strategic planning in several government organizations that lacked the requisite direction and vision necessary to improve their performance. Accordingly, this research uncovers difficulties that some governmental (federal) agencies experienced before the implementation of strategic planning. In other cases, the strong leadership and vision that was key in guiding some of the organizations through the development of the strategic planning process is noted. Overall, this project focuses on factors that led to new directions for government organizations that were in dire need of this tool. It also focuses on the relationship between these factors and the degree of "public-ness" of the agencies, and points out and describes techniques used by federal agencies to overcome those difficulties and improve their performance.

KEYWORDS: Public-ness, Strategic Planning

MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY

AEGIS PLATFORMS: USING KNOWLEDGE-VALUE-ADDED ANALYSIS TO ASSESS OPEN ARCHITECTURE IN SUSTAINING ENGINEERING

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The purpose of this thesis is to estimate the potential performance improvement in sustaining engineering (SE) when an open-architecture (OA) approach to system development is used. The basis of this thesis is that in integrated-warfare systems (IWS) acquisition, 80% of total lifecycle costs occur during the operation and support phase. This statistic demonstrates the necessity of measuring how the OA approach will affect the software upgrade and maintenance process for the AEGIS IWS lifecycle. Using OA, advances in distance support and monitoring and maintenance-free operating periods are possible, and this is significant in supporting the need to reduce costs and manpower while improving performance. To estimate the potential return on investment (ROI) that an OA approach might enable for SE in the form of software maintenance and upgrade, this thesis applies knowledge-value-added (KVA) methodology to establish the baseline "as is" configuration of the current solutions in AEGIS. The KVA analysis yields the ROIs and the current models for the approach to software maintenance and upgrade. Based on the assumptions of OA design for the original system development, new approaches to distance and maintenance and monitoring are explored in "to be" solutions, and the ROIs are estimated. The to-be solutions are rooted in the assumptions of MFOP and ARCI, and the results indicate that these solutions yield a potential improvement of 720%, and a cost savings of \$365,104.63 over the current methodology for just one ship. For all ships using AEGIS, ROI improves by 71,967%, with a cost savings of \$26,543,824.56. The conclusion is that OA enables extension of these best practice approaches to AEGIS maintenance and upgrade solutions.

KEYWORDS: AEGIS Platforms, KVA, KVA+RO, Sustaining Engineering, Distance Support

JOINT NETWORKING COMMAND-AND-CONTROL COMMUNICATIONS AMONG DISTRIBUTED OPERATIONS, JOINT CLOSE-AIR SUPPORT, AND JOINT FIRES

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This thesis postulates that the implementation of mobile, *ad hoc* networking (MANET), Mesh, and IEEE 802.16 products can support a distributed-operations (DO) platoon. Ground- and air assets will use MANET, Mesh, and IEEE 802.16 products to network a tactically deployed DO platoon through communications of ground- and air-based components. These ground- and air components will link in an IP-based network and demonstrate the real-time exchange of data. This analysis focuses on the integration of traditional airborne assets with those of a DO platoon. By connecting those sense, decide, and act (SDA) facets into a networked-based architecture, the thesis experiments demonstrate that emerging

SYSTEMS TECHNOLOGY

commercial, off-the-shelf (COTS) technologies can advance data exchange between service-oriented architectures (SOA) and improve joint close-air support (JCAS) to DO platoons in an environment where Air Force, Navy, and Army components are available for fire support.

This thesis focuses on the integration of ground and air nodes into a networked-based architecture using emerging COTS MANET, Mesh, and IEEE 802.16 technologies to further advance data exchange between simulated ground- and air units.

KEYWORDS: COTS, Mesh, 802.16, SDA, SOA, Distributed Operations, DO, Airborne Networking, WIMAX, WLAN, UHF, QOS, MANET, Redline, Tacticomp, Multi Mesh Router, Peer to Peer, Point to Multi-Point, JCAS, Joint Fires

NORMATIVE COMMAND-AND-CONTROL INFLUENCES: A STUDY OF COHESION IN TERRORIST ORGANIZATIONS AND THEIR EFFECT ON SOCIETY

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Current Afghani operations demonstrate the ability of terrorist organizations to flourish without clear structure. Such organizations likely adopt missionary or adhocacy structures, which are underdeveloped theoretically and empirically vis-à-vis organizational theorizing, particularly military command and control concepts. However, terrorist organizations are groups and thus subject to normal processes. From an open systems view of organizations, processes develop according to the operating conditions of a group. As conditions change internally and externally, groups must adopt norming strategies within the constraints of their environment. If a group is unable to maintain a norming structure, facilitating group cohesion and clear understanding of the group's mission, then it will likely fail to meet its objectives or cease to exist.

Thus, the ability of a terrorist organization to achieve its objectives is partially dependent upon its ability to influence, directly or indirectly, the society in which it operates. Terrorist organizations must entice people to willingly join a group that assumingly does not value less radical societal norms. This work studies norming processes within terrorist organizations. The study begins with a review of the norming literature and thus applies reviewed concepts to terrorist organizations. This project provides a foundation from which future researchers can test hypotheses related to terrorist groups and their environments from a normative perspective of command and control.

KEYWORDS: Terrorist Organization, Terrorist Group, Cohesion, Group Influence, Group Norms, Organizational Structure, Recruitment, Media

COUNTERTERRORISM TACTICS: A MODEL OF CELL DYNAMICS

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The modus operandi of various terrorist organizations have been studied extensively, and databases such as ITERATE collate details about terrorist attacks, including the types of technology used by terrorist organizations and number of resultant casualties. Surprisingly, however, a generalized model of how terrorist organizations plan their attacks is unavailable in the extant literature. Drawing from organizational theory, particularly command-and-control literature and case-study methods, this paper posits a generalized model of terrorist attack planning. By extending this model into the counterterrorism domain, methods to more optimally detect terrorist attacks are considered.

KEYWORDS: Counterterrorism, Terrorism Modeling

SYSTEMS TECHNOLOGY

THE IMPACT OF TELEVISION NEWS COVERAGE ON AL-QAEDA'S OPERATIONS

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Much of what the American public knows about al-Qaeda and its most prominent member, Osama bin Laden, has been delivered through television news. It is clear that al-Qaeda uses television news as an integral part of achieving their overarching goal, but whether television news has a reciprocal effect on al-Qaeda's future operations remains unclear. An analysis is conducted to determine if the timing of al-Qaeda's operations coincides with an increase or decrease in public awareness of the terrorist organization; this analysis is based on the volume of television news coverage received by both the organization and its founder.

KEYWORDS: Media, al-Qaeda, Osama bin Laden, Terrorism

A SYSTEMS APPROACH TOWARDS HIGH-ENERGY LASER IMPLEMENTATION ABOARD NAVY SHIPS

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The next generation of naval surface vessels will feature a weapon system with pinpoint accuracy, deep magazines, lower cost-per-kill shot ratio, and delivery at the speed of light; this transformational weapon system will provide significant advantages over the conventional systems of today. The free-electron laser maintains the greatest potential to become the Navy's first line of shipboard defense, and possibly, a major component in the national missile-defense shield. This is possibly because the free-electron laser will in theory be capable of scaling high power levels compared to those of the megawatt class, which is considered the threshold for military application. The focus of this thesis is to study the implementation of this directed-energy weapon from a systems perspective and determine if such implementation is plausible within the constraints of a naval platform. This thesis discusses the components of implementation such as electric drive, integrated power system, pointer-tracker system, etc., which are vital to the total-ship weapons package.

KEYWORDS: High Energy Laser, Free Electron Laser, Integrated Power System, Electric Drive, Deformable Mirrors

SYSTEMS TECHNOLOGY

COMMAND AND CONTROL FOR DISTRIBUTED OPERATIONS: AN ANALYSIS OF POSSIBLE TECHNOLOGIES, STRUCTURE, AND EMPLOYMENT

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For information to move efficiently in asymmetric combat, the military has had to flatten its organization and find ways to network those decision makers who impact the daily ebb and flow of events on the ground. This thesis further develops the concept of Marine Corps distributed operations (DO) under the current Marine Air Ground Task Force (MAGTF) structure. Analysis focuses on the integration of traditional RF nets into a networked-based architecture using emerging commercial, off-the-shelf, radio frequency to Internet-protocol (RF to IP) technologies that would advance the Marine Corps' MAGTF capabilities.

Evaluations include traditional Marine Corps ground-radio assets along with COTS equipment. Tests include laboratory and field settings. Key performance measures include interoperability, bandwidth measurements, range, and power consumption. Additional measures include interoperability with current Internet-protocol networks and methods of execution.

Findings support the bridging of military tactical ground radios into IP networks or into other IP enabled communication devices. Radio interoperability is investigated over various network mediums, such as IEEE 802.16, IEEE 802.11A, and Mesh links.

KEYWORDS: Twisted Pair WAVE, IEEE 802.16, Mesh, Distributed Operations, Tacticomp, Marine Corps War Fighting Lab, MCWL

MASTER OF ARTS

**National Security Affairs
Security Studies**

MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

THE NEW MIDDLE-EAST SECURITY THREAT: THE CASE OF YEMEN AND THE GULF COOPERATION COUNCIL

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Since Yemen has a history of border disputes with Saudi Arabia, this research addresses the question of Yemen's role in the security of the Arabian Peninsula. Yemen suffers from a weak economy and a number of security issues of its own. Through the borders shared with its Gulf Cooperation Council (GCC) neighbors, Yemen has become plagued by a nexus of terrorism, arms smuggling, and drug trafficking. Yet Yemen is unable to effectively combat these threats because of weak border control and poor cooperation with its regional neighbors, which points to the issues of border control and transnational cooperation within the GCC as an important area of research. The scope of this research encompasses and scrutinizes the role of borders and how terrorism flourishes through the peninsula. This focus allows researchers to observe what has been done and what could be done to solve this security threat. The thesis examines potential solutions to the problems created by border security and a lack of cooperation, and argues that a viable solution can be found by Yemen joining the GCC in a united force. This would help insulate the Arabian Peninsula from the internal threats the area is facing.

KEYWORDS: Arabian Peninsula, Border Conflicts, Cooperation, GCC, Gulf, Military, Politics, Terrorism, Yemen

BIOLOGICAL WEAPONS ATTRIBUTION: A PRIMER

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The possibility of an enemy attack using biological weapons (BW) remains one of the biggest threats to U.S. and global security. U.S. defense and deterrence policies are based on the assumption that the perpetrator can be quickly and reliably identified. If perpetrators can conduct attacks without fear of attribution or punishment, they can act with impunity. The ability to punish, therefore, rests on the ability to identify the perpetrator. Thus, the goal of attribution is at the root of all national security strategies. Unfortunately, there are three reasons why the attribution of BW attacks are very difficult: 1) the nature of biological weapons, 2) the unique restrictions the international environment places on BW attribution, and 3) the bureaucratic constraints and organizational overlap that domestic political environments can impose if a BW attack occurs. This thesis provides a basic epistemological framework for analysis for successful BW attribution, detailing the nature, methods, and limits of current BW attribution capabilities.

KEYWORDS: Biological Weapons Attribution, Biodefense, Epidemiology, Forensic Microbiology, Sverdlovsk, Amerithrax, Biological and Toxins Weapons Convention, BTWC, Anthrax

NATIONAL SECURITY AFFAIRS

EVALUATING RUSSIAN DUAL-USE NUCLEAR EXPORTS

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Non-proliferation is a major concern of the international community, the United States, and Russia. This thesis examines Russia's role in the non-proliferation regime through 2004. Russia has continually said it is committed to non-proliferation; however, some of its actions contradict its rhetoric. Although Russia's violation of international agreements on non-proliferation is minimal, it is important to understand why Russia transfers nuclear technology. This thesis uses two case studies — Russian nuclear sales to Iran and sales to India — to determine why Russia's actions fail to meet its rhetorical standards.

KEYWORDS: Russia, Non-Proliferation, Nuclear, India, Iran

PRIVATE MILITARY FIRMS AS INSTRUMENTS OF U.S. FOREIGN POLICY: THE CASE OF COLOMBIA

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Advisor: Jeanne Giraldo, Department of National Security Affairs

Second Reader: Thomas Bruneau, Department of National Security Affairs

This thesis assesses the costs and benefits of U.S. reliance on the private-military industry in its assistance to Colombia. U.S. policy in Colombia is characterized by an enormous military and financial effort to combat the drug trade and the violence of terrorist groups, which are heavily involved in the drug business. Private military firms (PMF) play a major role in the fight against drugs, particularly in the U.S.-funded aerial eradication program. In addition, the United States has relied on PMFs to assist in the transformation of the defense sector, which was a key part of Plan Colombia. Given the importance of Colombia to U.S. foreign policy, it is essential to determine whether PMFs have contributed to or undermined U.S. objectives in the country. In addition, the Colombian case sheds important light on the broader debate over the advisability of relying on PMFs as an instrument of foreign policy. The main argument is that even though PMFs have been subject to much greater regulation in the Colombian case than in other instances, the executive branch lacks the ability to oversee their activities adequately and there is still a significant deficit of accountability to Congress and the public.

KEYWORDS: Private Military Industry, Private Military Firms, Private Military Companies, DynCorp, Colombia, Contractors

THE ROOTS AND EVOLUTION OF THE ROYAL AUSTRALIAN NAVY

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Master of Arts in National Security Affairs-June 2007

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Second Reader: Michael S. Malley, Department of National Security Affairs

This thesis investigates the roots and evolution of the Royal Australian Navy (RAN), and the circumstances that have shaped Australian maritime policy since WWII. Its primary purpose is to provide present-day policy experts with historical insights useful to the planning of future relationships with Australia and her royal navy. In essence, this topic's intent is to assist in the formulation of United States maritime policies that will achieve optimal global results through the thoughtful engagement and proper support of Southeast Asia's predominant maritime power.

KEYWORDS: Australia, Royal Australian Navy, RAN, Sea-Power, Navies, Defense, Strategic Planning, Maritime Security, Australia History, Asia Pacific Security, Australia Military Policy

NATIONAL SECURITY AFFAIRS

THE PROSPECT OF CHINA'S ACCESS TO NAVAL FACILITIES IN BURMA AND THE RAMIFICATIONS FOR REGIONAL STABILITY

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Alice L. Miller, Department of National Security Affairs

This thesis examines the prospect of the People's Liberation Army's navy (PLAN) gaining access to naval facilities in Burma and the implications for the Asian-Pacific region. With much of China's energy resources sailing through the Strait of Malacca, Burma is in a strategic position to affect China's energy security design. If China were given access to port facilities in Burma to service the expanding Chinese naval fleet, it would give PLAN the ability to control maritime trade routes, as well as the ability to command strategic chokepoints along those routes, jeopardizing the security interests of the maritime powers that depend on these waters. The increase in PLAN's capabilities could generate an uncertain climate and prompt a build-up of rival naval powers in the region.

This thesis argues that although the PLA navy will be able to ply China's extended sea lines of communication with the help of Burmese naval facilities, Chinese naval vessels have not attained sufficient modernization to pose a major threat to the United States or regional powers. It is also unlikely that China would challenge the U.S., the current guarantor of freedom of navigation, for dominance of the sea. The danger will come from the regional instability caused by the naval arms race to counter the expanded capabilities of the PLA navy.

KEYWORDS: China, Burma, ASEAN, India, Japan, South Korea, Asia-Pacific, Southeast Asia, PLAN, Navy, Sea Lines of Communication, Energy, Oil, Military, Regional Cooperation, Modernization

THE RISE OF CHINA'S MIDDLE CLASS AND THE PROSPECTS FOR DEMOCRATIZATION

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Jessica R. Piombo, Department of National Security Affairs

Since Deng Xiaoping instituted economic reforms under the "reform and open" policy in 1978, the Chinese communist party has overseen a gradualist approach to modernizing China's economy. A new Chinese middle class has emerged with China's economic reforms and economic growth. According to Seymour Martin Lipset's modernization theory, there is a strong relationship between socioeconomic development and the emergence of democratic politics. The growth of an educated middle class, according to Lipset, will demand democratization as a means to achieve more participation in politics.

This thesis assesses the validity of Lipset's argument that socioeconomic development is likely to result in a democratic transition through the growth of a liberal middle class in the case of contemporary China. This research assesses how closely China's middle class fits Lipset's model and whether China's middle class displays characteristics that suggest that Lipset's framework of democratization will hold true in China.

Since spreading democracy around the world was reasserted as a long-range U.S. objective in the early 1990s, attention has focused on prospects for democratization in China. This thesis illuminates the political implications of China's growing middle class and argues that China's economic modernization does not guarantee democratization. This is important because the rationale for American politics of engagement with China rests in part on the assertion that economic growth over the long run may lead to China's democratization.

KEYWORDS: Barrington Moore, China, Chinese, Chinese Communist Party, Democratic Peace Theory, Democratization, Democracy, Developmental State, Liberalization, Middle Class, Minxin Pei, Modernization, Nuclear Non-Proliferation, Samuel Huntington, Seymour Martin Lipset, Socio-Economic Development, Taiwan, Transition, United States Foreign Relations

NATIONAL SECURITY AFFAIRS

NASSER AND PAN-ARABISM: EXPLAINING EGYPT'S RISE IN POWER

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This thesis explains Egypt's rise to preeminence in the Arabian Middle East from 1952 to 1967. It examines the implementation of President Nasser's domestic and foreign policies as prescribed by the ideology of pan-Arabism, and how this ideology, coupled with Nasser's dynamic personal leadership, allowed Egypt to rise in power and influence within the region. This thesis also considers how, after Nasser's death, the new policies and personal leadership of his successor, President Sadat, led to Egypt's abandonment of the role Nasser had staked out for the country. Sadat's refusal to allow the ideology of pan-Arabism to dominate his domestic and foreign policies opened the door for peace between Egypt and Israel, and marked the beginning of significant economic and strategic cooperation between Egypt and the United States.

KEYWORDS: Egypt, Gamal Abdel Nasser, Anwar Sadat, Pan-Arabism, Arab Nationalism, Regional Power, Domestic Policy, Foreign Policy, Infitah, Muslim Brotherhood, Arab Unity, Leadership, Free Officer's Corps

ÈGALITÉ OU RÉALITÉ: WHERE DO MUSLIMS TRULY RESIDE IN TODAY'S FRANCE?

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Master of Arts in National Security Affairs-June 2007

Advisors: Douglas Porch, Department of National Security Affairs

Donald Abenheim, Department of National Security Affairs

In this study, the author focuses on France, exclusively, to illuminate the potential causes for material and ideological support to terrorism in that society, and further indicates how these trends may be evident or potential throughout Western societies. In recent years, the word "Muslim" has become synonymous with terrorism in the lexicon of France and other Western societies. This thesis demonstrates that terrorism is not a spontaneous or standalone problem. Terrorism and other forms of extremism in France—whether imminent or imagined—mark an end form of the true issue: social exclusion, or alienation, or isolation of French Muslims. French society's republican values of liberty, equality, and fraternity make no distinction for such identity factors as ethnicity and religion.

This study focuses on the French headscarf ban, with its goal of promoting integration. This thesis demonstrates that the wearing of headscarves by Muslim girls in French society was manifested as a challenge to French identity and the tradition of laïcité, or secularism. These ideas, and others central to French-ness, are seen in the French polity as threatening, as well as a visual representation to the threat posed by the influx of Muslim immigrants and their failure to assimilate.

This thesis concludes by demonstrating that issues such as racism, Islamophobia, and social alienation or exclusion are the vehicles that radical Islamists prey upon to find potential jihadists. If the headscarf ban is politicized by the fundamental Muslim community, the ban ultimately might prove counterproductive, resulting in reduced integration in public schools, more segregation, and a radicalized Muslim community hostile to the Western traditions that France holds so dear.

KEYWORDS: France, Muslims, Integration, Stasi Commission, Laïcité, Islamophobia, Racism, French History, Contemporary French Culture

NATIONAL SECURITY AFFAIRS

THE EUROPEAN UNION'S POLICY REGARDING PEACE AND SECURITY IN SUB-SAHARAN AFRICA SINCE THE END OF THE COLD WAR: CONCEPTS AND IMPLEMENTATION

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Second Reader: Letitia Lawson, Department of National Security Affairs

This thesis analyzes the policy of the European Union (EU) towards sub-Saharan Africa since the end of the Cold War. The main research question is: has EU policy toward Africa changed fundamentally, and, if so, what are the motivating factors? This thesis argues that there is indeed a paradigmatic change in the Africa policy. Especially since the formation of the European Security and Defense Policy in 1999, the EU has become more active and capable in implementing its missions in the region.

The basic guiding documents, especially the *European Security Strategy* and the *EU Strategy for Africa*, are reviewed to trace the evolution of the EU's concepts. Then, the institutional, military, and civilian crisis-management capacities available to operate in that region today are investigated. A case study on EU intervention in the Democratic Republic of Congo from 2003–06 analyzes the scope and effectiveness of the EU's actions. It is shown that the EU has a unique variety of instruments available, which enable it to operate in a broad mission spectrum. Military and civil operations complement one another. The EU's policy is guided by its norms, by a new threat perception, and by France's national interests in that region.

KEYWORDS: European Union, EU, United Nations, UN, African Union, AU, Southern African Development Community, SADC, France, Great Britain, Sub-Saharan Africa, Conflict Prevention, Crisis Management, EU Strategy for Africa, European Security Strategy, ESS, European Security and Defense Policy, ESDP, Common Foreign and Security Policy, CFSP, EU Battlegroups, Security Sector Reform, SSR, Disarmament, Demobilization Reintegration, DDR, African Peace Facility, African Standby Force, Development Policy, Cotonou Agreement, Raid Reaction Mechanism, Democratic Republic of the Congo, DRC, Operation ARTEMES, EUFOR RD Congo, EUSEC DR Congo, EUPOL Kinshasa, Operations Headquarters, OHQ

A RERUN IN TURKEY: A COUP IN THE NEAR FUTURE?

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Master of Arts in National Security Affairs-June 2007

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Second Reader: Abbas Kadhim, Department of National Security Affairs

The purpose of this research is to investigate the historical stability of the Turkish government and to compare it to the present-day government; the intent is to reveal the likelihood of a coup attempt in the near future, as has often been seen in Turkey's history. Turkey has a proven status of importance to the United States by virtue of its strategic location, democratic pursuits, cultural status, and economic potential. This research delves into the country's past coup activities and related variables. The country's present-day status and potential future are analyzed to reveal a hypothesis of relative stability and progress for the country. This is significant, as there was a pending gap in research that suggested the possibility of Turkish instability, which would be counterproductive to the challenges of the United States in the region. The major contribution of this research suggests that Turkey's military will continue to play a key role in the country's decision making and oversee of the application of decisions by policy makers. However, should the country continue on its path, there is little reason to anticipate anything other than stability for the government of Turkey.

KEYWORDS: Incirlik Air Base, European Union, Islamic-Oriented Government, Turkish Republic of Northern Cyprus

NATIONAL SECURITY AFFAIRS

GERMANIA, QUO VADIS? DYNAMICS OF CHANGE IN GERMAN SECURITY POLICY

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Master of Arts in National Security Affairs-June 2007

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Richard Hoffman, Center for Civil-Military Affairs

This study analyzes the essence of Federal Republic of Germany (FRG's) security and defense policy after reunification. The first section briefly explains the different theoretical approaches to cooperation of nation states. The second chapter describes German security policy during the Cold War, and shows the force of continuity that Germany always preferred the security of NATO. The third chapter explains the German security policy from after the Cold War until 1998, and the advent of the Red-Green coalition. Theoretically, Germany had the opportunity after regaining total sovereignty to decide between NATO and the EU, or even a uniquely all-German security strategy. The Kohl administration is then compared with the Schroeder cabinet of 1998–2005.

The last chapter describes the strategic and operational capabilities of the German armed forces to demonstrate that a German-only path is an unrealistic option and that Germany is dependent on a deep integration into NATO and the EU. Finally, the role of German society is investigated to determine its influence on the choice to pursue a more independent European security structure, which was not only the result of the Schroeder administration, but of the demands of German society.

KEYWORDS: Germany, Security, NATO, ESDP, German Defense Policy

BETTER LUCKY THAN GOOD: OPERATION EARNEST WILL AS GUNBOAT DIPLOMACY

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In 1987, the United States agreed to register eleven Kuwaiti oil tankers under the American flag and to provide for their naval protection at the height of the Iran–Iraq War. Motivated primarily by Cold War considerations, the United States embarked on a policy of “neutral intervention.” The intended effects of this policy were certain to be disadvantageous to Iran. American planners failed to adequately anticipate Iranian reaction to the American policy, which led to a number of violent naval actions and American retaliatory strikes on Iranian oil facilities. Nevertheless, by April 1988 the United States had largely achieved its declared objectives, which were to secure the safe transit of Kuwaiti oil through the Gulf and to forestall the expansion of Soviet influence in the region. On 29 April 1988, however, the United States expanded the scope of the protection scheme, extending the U.S. Navy's protective umbrella to all neutral shipping in the Persian Gulf. This decision divorced the American policy from its original limited objectives, increased the likelihood of further confrontation with Iran, and laid the groundwork for the destruction of an Iranian airliner by USS *Vincennes* (CG-49).

KEYWORDS: United States, Kuwait, Iran, Iran - Iraq War, Persian Gulf, Gunboat Diplomacy, Tanker War, Merchant Shipping, Operation Earnest Will, Operation Nimble Archer, Operation Praying Mantis, *USS VINCENNES*

TAKING JIHAD OUT OF THE HANDS OF INFIDELS

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This thesis argues that the perceived justness of a call to jihad will resonate with the most dedicated and sincere audience and is a key component of the weaponization of the ideology. The response to this call

NATIONAL SECURITY AFFAIRS

generates ardent support in the form of individuals willing to kill or be killed in order to see the jihad succeed. In classical jihads, rulers were able to mobilize their nations for war when these conditions were met. Over time, the ideology of jihad has transformed in parallel with changes in the world system. Jihadist rhetoric continues to be incorporated in the ideologies of non-state actors, who have created ideological variants based on their own interpretations. This thesis seeks to explain how the Internet makes the jihad a potent global reality by negating the need for infidel alliances, personalizing the actions of its adherents, and distributing the message and methods of jihad to an indeterminate number of actors.

This thesis recommends that continual pressure, in the form of infiltration or cooptation of these sites, forces those who promote violent jihad ideologies to increase their cyber security measures, essentially raising the cost in terms of time, if not money. While these groups have evidenced a tremendous capacity for organizational learning and have significant resources, these resources are not endless. Part of a successful counter-ideological strategy needs to involve consistently applying pressure through the medium of the Internet raise the stakes of the game and alter the radicalization process.

KEYWORDS: Social Mobilization, Jihad, Radicalization, Religious Violence, Osama bin Laden, Middle East, Afghanistan

HEEDING CULTURAL PREROGATIVES: THE EVOLVING POLITICS OF WINE REGULATION IN FRANCE

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In France, wine's cultural value, identified here as the “politics of *terroir* (soil),” produces regulatory protection that contravenes the neoliberal principles implicit in economic globalization. The rise of political *terroir* as chronicled in this thesis illustrates how and why such seemingly irrational anti-liberal sentiment can come to play an important role in national politics. The national trade policies that derive from this type of cultural politics often impact the global economy and its institutions. Imperiled Western and European agricultural products, one of which is French wine, presently play a key role impeding global free trade. Still, the political history of French wine indicates that some products, along with their attendant models of organization and production, can become deeply embedded in national identity, thereby making resistance to change especially fierce. Indeed, this account affirms that global policy makers should not soon expect rational adaptation to liberal markets where culturally valuable agricultural goods are threatened.

KEYWORDS: France, Globalization, Terroir, French Wine Politics, Wine Culture, Appellation d’Origine Contrôlée, AOC, la Crise, Wine Regulation, Communal Production, Haute Culture, Market Intervention

A CASE STUDY IN TRANSNATIONAL CRIME: UKRAINE AND MODERN SLAVERY

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Master of Arts in National Security Affairs-June 2007

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This thesis explores the roots of modern slavery (human trafficking) in post-Soviet space through a Ukrainian case study. Ukraine is scrutinized in an attempt to explain how the export and enslavement of hundreds of thousands of Ukrainians came about. An analysis of governance, social conditions, and economic conditions in Ukraine is provided, including a subsequent evaluation of why Ukraine has been unable to manipulate political, legal, social, and economic variables to end the export of their people.

A summary of central causal explanations includes rapidly expanding criminal enterprises and little government capacity to counter them. The problem is aggravated by a need for migration among potential victims that is accelerated by economic and social conditions, and a lack of legitimate means to find work abroad or meaningful work at home. Searching for answers inside Ukraine and surveying the prolific

NATIONAL SECURITY AFFAIRS

demand for Ukrainian slaves in many countries, this research examines these findings, then explores some policy options, such as encouraging legal migration opportunities, economic development, education programs, expanding relationships between nongovernmental organizations (NGO) and states, universal victim-assistance hotlines staffed by professionals, and a fund to reimburse victims.

KEYWORDS: Human Trafficking, Slavery, Modern Slavery, Trafficking, Transnational Crime, Criminal Networks, Migration, Black Market, Shadow Economy, Ukraine, Post-Soviet Issues, Human Rights, Prostitution, Bonded Labor, Orphans

CRIMINALS AND INSURGENTS: THE ROLE OF ETHNICITY IN STATE RESPONSES TO INTERNAL-RESOURCE COMPETITORS

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Master of Arts in National Security Affairs-June 2007

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A government facing an ethnicity-based insurgency competing with it for natural resources faces different threats based upon the level of ethnic homogeneity of the insurgent elements. Where a mono-ethnic insurgent threat develops, the government faces a potential separatist movement seeking secession from the country as a means to address its grievances. The government will have no option other than counterinsurgency to manage this threat. Where a multi-ethnic insurgent threat develops, the threat of separatism may be thwarted due to the disparate nature of the insurgent elements and the tendency of these groups to compete with each other. In this scenario, the government has the ability to “criminalize” the insurgents, thereby enabling the government to justify safeguarding its resources while taking minimal steps to resolve the grievances of the communities. An examination of the approaches taken by Indonesia and Nigeria in addressing their insurgencies in Aceh and the Niger Delta, respectively, is illustrative of the advantages and drawbacks of these approaches. In the end it is shown that counterinsurgency is more difficult though decisive, while criminalization ultimately risks the creation of a new ethnic identity born of economic hardship, around which an ethnic nationalist movement might vie for secession.

KEYWORDS: Ethnic Conflict, Ethnic Insurgency, Ethnic Rebellion, Nigeria, Niger Delta, Indonesia, Aceh, Resource Competition. Counterinsurgency

INTERNATIONAL POLITICS OF THE REINCARNATION OF THE DALAI LAMA

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This thesis analyzes Mongolia’s strategic options in the event of a Mongol-Chinese confrontation over a clash of interests arising from the potential succession of the next Dalai Lama, understood religiously in Mongolia through a process of reincarnation. Mongolia would welcome the Dalai Lama’s reincarnation in the country because Tibetan Buddhism enjoys the allegiance of many of Mongolia’s people and is a part of Mongolia’s national identity. Mongolia’s democratic government in Ulaanbaatar must therefore respond to its people’s religious sentiments.

Theoretical considerations regarding the rational behavior of small powers suggest that Mongolia would likely seek to maximize its interest by manipulating the interests of great powers to balance against China. Insight into Ulaanbaatar’s dilemma in such a circumstance may be gained from the current cross-Strait politics regarding Taiwanese independence, in which voter preferences favor Taiwan’s independence and lead it to balance with the United States against China’s growing military power. This thesis argues that even though Beijing is unlikely to threaten Mongolia with military power, since such steps would negatively affect its relations with Moscow and its reputation among the international community, it could

NATIONAL SECURITY AFFAIRS

nevertheless exert pressure on Ulaanbaatar. In such a circumstance, American, Russian, and Indian support for Mongolia would be crucial to countering Beijing.

KEYWORDS: Mongolia, Tibet, Dalai Lama, Reincarnation

THE KANTIAN PEACE AND GREEK–TURKISH RELATIONS

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This thesis applies the principles of Immanuel Kant’s “perpetual peace” to a study of the historical relations between Greece and Turkey. According to Kant, three principal elements—democracy, economic interdependence, and international organizations and international law—interact to promote peaceful relations among states. This thesis analyzes these three elements in respect to the relationship between Greece and Turkey throughout history.

The thesis concludes that Kant’s three elements have been influential in Greek–Turkish relations. Historically, the states’ interdependence has had, in general, a positive effect. But the conjunction of the three elements, as evidenced mostly through the European Union, suggests the most peaceful future for the two states.

KEYWORDS: Kant, Democratic Peace, Economic Interdependence, International Organizations, International Law, Greece, Turkey

SECURITY CULTURE IN TIMES OF WAR: HOW DID THE BALKAN WAR AFFECT THE SECURITY CULTURES IN GERMANY AND THE UNITED STATES?

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Master of Arts in National Security Affairs-June 2007

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Donald Abenheim, Department of National Security Affairs

This thesis uses a comparative case-study approach to examine how security cultures change under the impact of political shocks and learning through failure. The thesis thus analyzes the security cultures of Germany and the United States as they evolved under the impact of the war in Bosnia–Herzegovina from 1992 to 1995. The thesis also enhances understanding of German and U.S. foreign policies. Using paired observations for controlled comparison, the thesis employs process tracing to examine the nature and quantity of change. The case studies demonstrate that security cultures influence the assessment of political situations, restrain policy objectives, and condition the range of issues to which political attention is devoted. Both cases reveal that security cultures affect the evaluation of policy options and the choices that are made. The thesis argues that different transformations of German and U.S. security cultures led to divergent political behavior, particularly with regard to the use of force, resulting in more forceful and effective interventions in Bosnia and a reframing of future interventions in third-party conflicts. Domestic reactions to the Bosnian war transformed the security culture in Germany, whereas reactions in the U.S. triggered a re-ranking of cultural preferences. Understanding how security cultures change and evolve through exogenous and endogenous factors improves the chances of policy success in today’s challenging international environment.

KEYWORDS: Germany, United States, Security Culture, Strategic Culture, Cultural Change, Cultural Preferences, Bosnian War, Balkan Wars, Formative Events, Political Shocks, Foreign Policy, Crisis Management, Crisis Intervention, Use of Force

NATIONAL SECURITY AFFAIRS

NATO: FROM SHADOW TO SUBSTANCE—THE FORMATIVE YEARS, INSIGHTS FOR THE 21ST CENTURY

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Master of Arts in National Security Affairs-June 2007

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Critics of the North Atlantic Treaty Organization (NATO) have denigrated its purpose and scoffed at its principles of consensus and sharing the burdens of defense. To many, it has been flawed from the outset as concerns its American business principles, false promise of democracy, and claim to be a basis for durable peace in Europe. Yet NATO may be the most successful security institution in modern history, even as it wages war for the second time in a decade. This study assesses underlying causes for this success by examining NATO's foundation, against the background of war and peace in 20th-century Europe. Embracing the discipline of history as the ideal method of inquiry to discover the essence of this alliance, as well as the fundamental issues of democracy and collective defense in the 21st century, this study contains a thorough examination of NATO's origins and general principles of same for the present. Covering NATO from its inception, well before the end of the 1939–1945 war, until the signing of the North Atlantic Treaty in April 1949, this work contains an inventory of historical knowledge to provide a comprehensive history of NATO's formation and a full appreciation of the conditions within which related decisions were made.

KEYWORDS: NATO History, 20th Century European History, Cold War, Post-World War II

MEXICAN MIGRATION: ASSESSING ROOT CAUSES

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This thesis asks two major questions. Does Mexican migration (authorized and unauthorized) pose a threat to the United States? What are the major forces, or “push” factors, compelling migration from Mexico to the United States? The thesis focuses on a number of potential factors driving the migration: political change, crime, poverty, and Mexico's economic growth level and social inequality. It finds that illegal immigration from Mexico poses very little economic threat to the United States, but by complicating U.S. efforts to achieve border security, it may allow for an increased risk of undetected entry of terrorist or narco-trafficking elements into the United States.

The economic crises of 1982 and 1994 increased migration by directly impacting the political system, economic reforms, and social landscape. This caused a three-fold increase in migration from 1980 through 2000. In 2000, the Mexican economy recovered and the rate of increase for migration decreased. The upswing in the Mexican economy, combined with the democratic transition of 2000, slowed the rate of migration.

Instead of pouring more money into short-term solutions (i.e., apprehension and fences), emphasis should shift to working on longterm solutions that focus on the source of Mexican migration, economic downturns. With a better understanding of the contributing factors and the degree to which they affect the levels of all economically driven migration, the United States can work with Mexico to develop measures that will reduce and control illegal migration in the long run.

KEYWORDS: Migration, Unauthorized Migration, Immigration, Illegal Immigration, Economic Crisis, Mexico

NATIONAL SECURITY AFFAIRS

UNITED STATES' ENGAGEMENT STRATEGY FOR NORTH KOREA
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This thesis examines the debate that exists in the international community about the most effective way to deal with the threat of North Korea. A look back in history, especially in the case of the United States' past policies, serves as an analogy and historically based perspective to apply to the North Korean problem. The United States has employed both military engagement and economic engagement in various countries. Because of the regional parallels between the Korean and Vietnamese nations, the U.S. approach to the Vietnamese problem after the end of the Vietnamese war, a constructive engagement approach, was useful. Expanding diplomatic and economic ties with an authoritarian government is the most effective way to help move it in the direction of free markets and democracy. This same strategy should be tried with North Korea.

KEYWORDS: United States Engagement, North Korean Engagement, Economic Engagement, Military Engagement, Soft Power, Hard Power

COUNTERTERRORISM POLICY IN COLOMBIA
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The purpose of this thesis is to suggest a coherent, credible, and long-term counterterrorism policy in Colombia. The events of September 11, 2001, heightened U.S. awareness of Colombian terrorist organizations, the most powerful being the Revolutionary Armed Forces of Colombia (FARC). The U.S. counter-terror approach in Colombia appears fragmented, with only minor changes to its previous drug control policies. In contrast, the Colombian government has developed and implemented a policy to combat the FARC. To analyze the effectiveness of the Colombian government's efforts, this thesis takes a two-step approach. First, it aims to clearly define the threat posed by the FARC, and, in doing so, expose its center of gravity. With the intent of moving beyond the grievance versus greed debate, this thesis analyzes five characteristics of the FARC. The conclusion drawn is that it is most accurate to characterize the FARC as a "resource-based" insurgency with territory as its center of gravity. Second, the thesis assesses current U.S. and Colombian policy and finds that it is effectively attacking the FARC's center of gravity, and these efforts must be sustained if the FARC is to be defeated or forced to the negotiating table.

KEYWORDS: Colombia, FARC, Revolutionary Armed Forces of Colombia, Terrorism, Counterterrorism, Insurgency, Counterinsurgency, FARC

**THE CONFLICT AFTERMATH - A CHANCE FOR DEMOCRACY: NORM DIFFUSION IN
POST-CONFLICT PEACE BUILDING**
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Democratization in post-conflict situations is a major challenge, now and in the foreseeable future. Yet, the puzzle of why some of these attempts fail and others succeed is unresolved. This thesis argues that post-conflict democratization by third parties is, at its core, a norm-diffusion process. Successful democratization depends foremost on the acceptance and internalization of democratic norms by the target

NATIONAL SECURITY AFFAIRS

society. Knowledge of the norm-diffusion concept, especially the influence of the two variables—cultural match and norm empowerment—on the process might lead to the development and application of better democratization strategies. This thesis argues that post-conflict situations with their specific features—primarily characterized by value disorientation—offer a unique opportunity for a democratic transition. It examines the cases of the Weimar Republic, the Federal Republic of Germany, and Bosnia and Herzegovina (Bosnia) in order to demonstrate the explanatory power of the norm-diffusion theory, specifically its added value in studying success and failure of past and present democratization after conflict.

KEYWORDS: Post-Conflict, Peace Operations, Norm Diffusion, Democratization, The Weimar Republic, The Federal Republic of Germany, Bosnia and Herzegovina

WHEN ISLAMISTS TURN VIOLENT

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This thesis attempts to show that there are patterns to the behavior of Islamist groups that eventually resort to separatist violence against the state. The goal of the thesis is to create a framework illustrating certain indicators, or signs, as to if or when violence against the state will take place. The primary audience for the framework is military regional-affairs officers (RAO).

Islamic separatist violence is an ongoing phenomenon in several regions of the world and can have severe security and humanitarian implications that affect an entire region. RAOs are particularly concerned about possible international repercussions: military and political involvement from nearby states, instigation of similar secessionist movements in neighboring states, or the creation of international refugees.

This thesis reviews the popular literature on ethnic, separatist, and religious violence and draws on the potential indicators of violence described in the literature. The relevance of each indicator is validated through two case studies involving Islamic separatist movements: the Filipino Muslims in the southern Philippines and the Malay Muslims in southern Thailand.

KEYWORDS: Islamist Groups, Separatist Violence, Separatism, Islamic Violence, Indicators of Violence, Political Representation, Societal Alienation, Religious Revival, Philippines, Filipino Muslims, MNLF, MILF, Mindanao, Thailand, Malay Muslims, PULO, RAO

EUROPEAN SECURITY AND DEFENSE POLICY: DIALECTICS OF AUTONOMY

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France and Great Britain jointly declared Europe's desire for an autonomous security and defense capability in St. Malo, France, on December 4, 1998. Using the Western European Union as a springboard, the European Union created a second pillar, wherein lies the Common Foreign and Security Policy (CFSP) and the European Security and Defense Policy (ESDP). To what degree has ESDP helped Europe achieve its goal of autonomous security and defense? This thesis explores the concept of autonomy with respect to the European Union's civil-military operations policy under ESDP by considering intra-organizational relations (autonomy within organizations) and inter-organizational relations (autonomy among organizations) employing principal-agent and resource-dependency theory. A dialectic concept of autonomy is then applied to ESDP and examined through a case study of ESDP civilian and military operations in the Democratic Republic of the Congo. While the EU's civilian operations exercise a fairly

NATIONAL SECURITY AFFAIRS

high degree of autonomy, its military operations are considerably constrained due to member-state prerogatives, a capabilities gap, subjection to United Nations Security Council approval, and resource dependence on the North Atlantic Treaty Organization.

KEYWORDS: Autonomy, European Security and Defense Policy, ESDP, European Defense, European Union, EU, Western European Union, WEU, Common Foreign and Security Policy, CFSP, United Nations Security Council, UN, North Atlantic Treaty Organization, NATO, Inter-Organizational Relations, Intra-Organizational Relations, Principal-Agent Theory, Principal-Actor Theory, Resource Dependence Theory, St. Malo, Democratic Republic of the Congo, DRC

THE 1974 CRISIS OVER CYPRUS: FOREIGN WILL OR ETHNIC CONFLICT?

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This thesis presents a study of the Cyprus crisis, which lasted many years and concluded with the bloody events of the summer of 1974. The intervention of the military dictatorship from Greece and the subsequent Turkish invasion may have been the culmination of this crisis, but this thesis will show, contrary to common perceptions, that the causes of the crisis were not primarily a function of ethnic hatred.

This thesis concludes that the reasons for the conflict are found mainly in the actions of the international powers and the consequences of the Cold War. Based on these findings, the thesis explains the unsuccessful efforts of the United Nations to find a compromise and a solution that is accepted by the people of Cyprus.

Lastly, the thesis outlines a plan that could be approved by all Cypriots and offer unity and stability in Cyprus, based on the mandates and the protection of international organizations.

KEYWORDS: Ethnic Conflict, Cyprus, Greek Dictatorship, Turkish Invasion

UNITED STATES-ISRAELI RELATIONS: THE IMPACT ON U.S. NATIONAL INTERESTS

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This thesis assesses the effect of the United States' relationship with Israel on U.S. foreign policy objectives in the Middle East. An analysis is conducted of U.S. interests and relations in the Middle East, separate from considerations of domestic politics, to determine whether U.S. foreign policies in fact further national interests. Three U.S. national interests in the Middle East are analyzed: 1) nonproliferation of weapons of mass destruction, 2) spreading democracy, and 3) combating terrorism respective to Iran, Syria, and Egypt, to conclude whether the national interest is positively, negatively, or negligibly affected by the U.S.-Israeli relationship. While the thesis highlights possible interests and areas where American national interests are not well served by the U.S.-Israeli relationship, the thesis does not conclude that the U.S. should withdraw support of Israel. It is in American interests to support the existence of its allies. However, the thesis does conclude that greater objective debate should take place to assess the U.S.-Israeli relationship with respect to other U.S. national interests in the Middle East to ensure American national security is best served by current policies.

KEYWORDS: Israel, Iran, Syria, Egypt, National Interests, Middle East, Arab-Israeli Conflict, Democracy, Terrorism, Proliferation

MASTER OF ARTS IN SECURITY STUDIES

IMPLEMENTATION OF THE ABUJA 11 ACCORD AND THE POST-CONFLICT SECURITY OF LIBERIA

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This thesis shows that the Economic Community of West African States (ECOWAS) and the international community, in a bid to secure an end to Liberia's intractable civil war, agreed to share political power among Liberian warlords. It demonstrates that that the arrangement that granted the warlords political legitimacy and considerable influence and control over the transition process practically led to the unsustainable warlord peace of postwar Liberia in 1997. It further shows that the focus and preoccupation of the warlord-dominated council, ECOWAS, and the international community, with the 1997 elections as a means of peacefully resolving the conflict, resulted in the failure to restructure security forces before the inauguration of the post-election government as stipulated by the Abuja Agreement. The failure to restructure the security forces offered the post-war Taylor government the opportunity to carry out a bogus exercise inconsistent with the Abuja Agreement, an opportunity that he readily seized. The exercise resulted in the selective demobilization and gradual marginalization of the Krahn-dominated armed forces of Liberia, and the creation of several new armed units dominated by former National Patriotic Front of Liberia (NPFL) militias. These units, and the ruthlessness with which they operated, escalated fears of vulnerable former adversaries and contributed significantly to the resumption of war in 1999.

KEYWORDS: Power Sharing Arrangement, Armed Forces of Liberia, Restructuring of the Security Forces, Appeasement Strategy, Transitional Government, Interim Government, Abuja Agreement, Consensus, Peace Enforcement

PEASANT PROTEST IN KYRGYZSTAN: STANDING UP NEXT TO A MOUNTAIN

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This thesis seeks to explain peasant protest in Kyrgyzstan in both the Akaev- and post-Akaev era through an analysis of five case studies spanning both periods. This thesis finds that during the Akaev era, successful mobilization occurred in the rural areas, when protestors were able to project their agendas and anger beyond the local arena. By framing the original issue of grievance as an issue of national concern and employing aggressive methods of redress, such as road blockades and occupation of public spaces, Akaev-era protestors met with success on two of three occasions. The post-Akaev era has been marked by a transition to urban-based protests, which has reduced the methods of redress available to protestors and elicited mixed results. Throughout the cases studied, the motivations of the peasant protestors is best explained by a loss-aversion theory of human behavior, which stipulates that actors will accept high risks of action when they perceive that they have lost something previously attained. While peasants are traditionally thought of as conservative and risk-averse, the Kyrgyzstani peasantry has displayed a

willingness not just to initiate protest, but to sustain protest until such a time as such losses have been regained.

KEYWORDS: Kyrgyzstan, Protest, Peasantry, Democracy, Social Mobilization, Akaev, Post-Akaev

THE PACE OF PEACE ON THE VIABILITY OF BOSNIA AND HERZEGOVINA, TWELVE YEARS AFTER DAYTON

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The fratricidal war in Bosnia and Herzegovina (BiH) between 1992 and 1995 was the third and most brutal chapter in the dissolution of the former Yugoslavia. The war left the country devastated and deeply divided along ethnic lines. Pursuant to the impotence of the international community (IC) to stop the fighting and after the humanitarian and political consequences of the war had finally become unbearable, a delicate and complicated compromise was hammered out in Dayton.

An immense international investment has taken place in the twelve years since the signing of the Dayton peace accords. While official rhetoric by the IC seems to suggest that there is constant progress in state- and nation building, academic, in-depth studies and close political observers are more skeptical. There is no consensus as to how viable BiH is today.

This thesis first develops various criteria for state viability in ethically divided societies, which is derived from the literatures on strong and weak states and on the post-Westphalian system. This concept is then applied to Bosnia. Since internal and external security are the principal political goods deliverable for the inhabitants of any state, and taking into consideration that the state has to have the monopoly over the legitimate use of force, the defense-reform process since 2003 is considered the major indicator for the state viability of Bosnia today. The thesis concludes that despite much progress, Bosnia is not yet viable without further international contribution.

KEYWORDS: Bosnia and Herzegovina, Dayton Peace Accords, State, Weak and Failing States, Defense Reform

STUDENT INDEX

A

Acosta, David A., 65
Adler, Jameson R., 99
Ahart, Jennifer L., 99
Akel, Kamil, 85
Alabarda, Yusuf, 11
Alanc, Ozgun Utku, 11
Alden, James G., 45
Al-Hajjri, Ibrahim A., 105
Allen, Charles A., III, 29
Angelis, Ioannis, 15
Arbulu, Timothy D., 12
Ashby, DeAngelo, 12

B

Bahr, Elizabeth L. Stone, 105
Baltos, Georgios, 13
Barbosa, Adriano M., 45
Batson, Mickey S., 3
Berg, William R., 67
Bitterman, Blaine S., 106
Bock, Paul B., 71
Bommer, John S., Jr., 99
Boseman, John F., 53
Botkin, Bradford L., 13
Botsakos, Michael T., 81
Boysen, Matthias, 106
Brizek, Jason M., 46
Burkett, Rex D., 14
Burroughs, John C., 69
Butler, Richard D., 106

C

Carter, Donald, 37
Casias, Juan Francisco, 53
Chacón, Orlando A. Cubillos, 14
Chang, Chin-Hao, 15
Chin, Victor A., 107
Cichon, Frederick A., 107
Ciolponea, Constantin A., 46
Cole, Zachary K., 95
Conti, Karen M., 43
Coomes, Donald E., 83
Cox, Matthew B., 69
Crabbe, Kendra L., 93
Craig, Clayton A., 102
Cross, Christopher Gene, Jr., 3
Cullen, Maurice G., 15

D

Dahl, Gustave C., 73
Danielson, Robert E., 108
Davis, Michael A., 108
Deal, Eric J., 50
Deligiannidis, Ioannis, 15

Dendis, Alexandros, 73
Denizer, Gokhan, 16
Desinioti, Anthi, 16
Doherty, Brian D., 85
Döring, Stephan, 109
Drivas, Athanasios C., 54
Dunfee, David A., 33

E

Eatinger, Christopher J., 37
Eck, Larry R., 71
Ellenburg, Christine A., 100

F

Feix, Miroslav, 47
Felder, Eric D., 74
Fletcher, Douglas M., II, 27
Foust, Coleen A., 19
Foust, Shawn J., 109
Freye, Jeffrey T., 86
Fry, Bryan D., 86

G

Garcia, Baldomero, Jr., 54
Garrity, Maura C., 81
Garvey, Jennie Hill, 55
Gibson, Hise O., 87
Gibel, Kathleen A., 100
Gkinakis, Nektarios, 16
Gkionis, Charalampos, 55
Greenbaum, Rebecca L., 101
Greene, Todd R., 74
Gundemir, Mert, 17

H

Harris, Thomas Lee, II, 97
Hegler, Benjamin L., 33
Hentz, Patrice R., 33
Herkamp, John Frederick, 95
Hey, Nikolaus, 110
Ho, Chih-Haur, 19
Hodgson, Terry L., 47
Holbrook, James A., II, 101
Hopeman, Amber, 45
Horsman, Stephen J., II, 79
Howell, Jeffrey M., 87
Hu, Cecilia X., 34

I

Iancu, Cristian A., 46
Ikeda, Ryo, 17
Ikomi, Emmanuel Oritsejolomi, 119

STUDENT INDEX

J

Jackson, Michael J., 65
Johnson, Glenn, 48

K

Kampouridis, Anastasios, 96
Katopodis, Panagiotis, 29, 55
Katsis, Grigorios, 56
Katzourakis, Ioannis, 57
Kelley, Stephen A., 110
Kerutis, Aidas, 19
Kidd, Daniel C., 74
Knitt, Matthew C., 34
Koeppel, David M., 75
Koerner, Heather L., 34
Koesler, Joseph J., 75
Koliouisis, Dimitrios S., 57

L

Laboo, Brett N., 88
Lacey, Wayne R., 51, 65
Lalis, Vasileios, 88
Leos, Leonard, 18
Lewis, Gregory W., 110
Liburd, Alice Y., 67
Lisowiec, Rafal, 11
Lober, Colin W., 119
Louden, Thomas, 18
Luebbert, Brian, 18

M

MacLean, Christopher D., 111
Magoula, Angeliki Elen, 19
Manalang, Ronaldo, 17
Manos, Eleftherios, 58
Margolies, Joseph M., 14
McDonald, David K., 79
McDonald, Fritz, 19
McDonald, Gordon R., 34
McLemore, Trevor D., 35
Meng, Alvin Tan Soon, 72
Mentzer, John R., 76
Metzger, Paul, 17
Mitchell, Robby J., 89
Mitsopoulou, Zoi, 13
Monroe, Dennis W., 82
Moore, Kevin L., 19
Morris, Erwin C., III, 46
Mugg, David E., 48
Murphy, Edmond J., 38
Myers, Christopher S., 19

N

Nader, Cesar E., 20
Neff, Jodi, 45

Nicholas, Matthew L., 111
Norton, William J., 20
Novack, Edward W., 112

O

O'Reilly, Michael T., 70
Oliver, Derek M., 89
Otgonbayar, Mashbat, 112
Oymak, Okan, 90

P

Packard, Matthew G., 33
Papalexidis, Nikolaos, 7, 58
Park, Si-Won, 90
Patsikas, Dimitrios, 30, 59
Peña, Leonardo I., 49
Penetrante, Wendel D., 76
Peteinarakis, Emmanouil, 113
Phelps, David A., 38
Pitel, Joel, 17
Poor, Kristopher D., 82
Poulin, Robert J., 38

R

Radtke, Robert D., Jr., 91
Ramsey, Avonna S., 67
Reiche, Charles P., Jr., 39
Reimers, Frank, 113
Reyes, David L., 101
Reynolds, Thomas E., 97
Rodgers, Michael E., 114
Rogers, John Henrik, 39
Rost, Michael C., 40, 93
Rouleau, Paul, 18
Roum, Chad J., 21
Rysavy, Joseph C., 21

S

Sardana, Vikram, 59
Schang, Suzanne L., 22
Schenk, Michael A., 76
Schroeder, Matthew K., 30
Scinicariello, Antonio L., 12
Scott, Petrocelli D., 114
Seaman, Nathan L., 68
Sears, David C., 49
Seiber, Lones B., III, 115
Self, Kevin A., 115
Semko, David A., 60
Shameem, Mohammad, 22
Shaver, Jonathan, 60
Slaff, Randolph E., Jr., 77
Sledz, Daniel A., 83
Smeltz, Jeremy M., 40
Smith, Wade K., 14

STUDENT INDEX

Smuda, William James, 4
Stevens, John D., 4
Stolzke, Michael, 115
Sundberg, Jeffrey P., 91
Szonyegi, Janos, 120

T

Taylor, Brian J., 92
Temple, Daniel W., 116
Thomas, Glenn R., 47
Thomas, Kyle B., 14
Thompson, Matthew F., 77
Thompson, Stephanie, 83
Tiantioukas, Nikolaos, 60
Tolle, Glenn A., 50
Torres, Juan C., 31
Tsirlis, Christopher S., 102
Tzellos, Konstantinos, 61

V

Valerius, Andrew J., 40
Vannaman, Tad D., 116
Vasquez, Henry S., III, 12
Vincent, Patrick J., 5

Vlachos, Ioannis, 117
Vosberg, Brian J., 12

W

Wadsworth, Mark, 18
Walker, Joshua H., 50
Walzer, Lawrence M., 117
Wegner, Christopher M., 92
Went, Allison P., 63
White, Kenneth P., 23
Wiese, Brian Keith, 41
Williams, Patrick S., 96
Williams, Robert J., 23
Williamson, Todd A., 31
Winn, Nathan, 18
Wolf, Joshua P., 14
Wolf, Rebecca E., 94

Y

Young, Lester, 97

Z

Zahn, Matthew A., 51
Zastrow, Daniel P., 61

ADVISOR INDEX

A

Abenheim, Donald, 108, 110, 113, 114,
115, 116, 117
Ahner, Darryl K., 86, 89
Apte, Aruna, 17, 18
Armstead, Robert L., 29, 96
Arquilla, John, 50
Ateshian, Peter R., 57
Auguston, Mikhail, 4, 37, 38

B

Barreto, Albert, 67, 68
Bartlett, Scott W., 74, 77
Baylouny, Anne Marie, 117, 119
Biermann, Rafael, 109, 113, 115, 116, 120
Borden, Brett, 95
Borer, Douglas, 45, 46
Brinkley, Douglas E., 12
Brook, Douglas A., 17, 18, 23
Bruneau, Thomas, 106
Brutzman, Donald, 82, 83
Buddenberg, Rex, 99, 102
Buttrey, Samuel E., 21, 33, 71, 85, 90, 91

C

Candrea, Philip, 21, 67
Carlyle, W. Matthew, 35, 87
Cha, Sang Myung, 90
Clunan, Anne L., 105, 106, 111, 119
Collins, Curtis, 83
Colson, William B., 29, 96
Cook, Glenn, 99
Coughlan, Peter J., 20, 22, 71
Crawford, Alice, 69
Cristi, Roberto, 4, 7, 58, 60, 61
Crooker, Peter P., 31, 95
Cuskey, Jeffrey R., 13, 14, 15, 22

D

Darken, Christian J., 82
Darken, Rudolph, 81
Dell, Robert F., 85, 87, 88
Denning, Dorothy, 45, 50, 51, 65
Dew, Nicholas, 11
Dinolt, George, 38
Dobrokhodov, Vladimir, 76
Durkee, Philip A., 79

E

Eagle, Christopher, 37, 38
Euske, Kenneth J., 12, 19
Ewing, Paul L., LTC, USA, 34, 87, 91

F

Fargues, Monique P., 57, 60
Feemster, Mathew, 60
Ferrer, Geraldo, 16
Fouts, Douglas, 60
Fox, William, 47
Franck, Raymond E., 11, 12, 15
Fricker, Ronald D., Jr., 33, 34

G

Gannon, Anthony, 75
Garrett, Stephen, 111
Gates, William R., 19, 20, 22, 71
Gera, Ralucca, 27
Gibbons, Deborah, 13
Gibson, John, 38, 39
Giordano, Frank R., 47, 48
Giraldo, Jeanne, 106, 114, 115
Gordis, Joshua H., 73, 76
Greenshields, Brian, Col, USAF, 47
Gregg, Heather S., 51, 65, 105, 110
Gustaitis, Peter J., 46, 48, 49, 50
Guttieri, Karen, 49, 119

H

Ha, Tri T., 54, 57, 61
Haegel, Nancy M., 96
Harkins, Richard M., 31, 95, 96
Hatch, William, 20, 71
Hensel, Nayantara, 13
Hernandez, Alejandro, COL, USA, 87
Hewett, Dennis, 3
Hobson, Garth V., 73, 75
Hocevar, Susan P., 70
Hoffman, Richard, 110, 114
Hoivik, Thomas H., 19
Housel, Thomas J., 68, 99
Hsia, Renee, 72
Hughes, Wayne, 50
Hutchins, Susan G., 81

I

Iatrou, Steven J., 101
Irvine, Cynthia, 37, 41

J

Jacobs, Patricia, 92
Jansen, Erik, 45
Jones, Becky, 14, 16
Joseph, John, 83

ADVISOR INDEX

K

Kadhim, Abbas, 105, 109, 110
Kaminer, Isaac, 76
Kang, Keebom, 90
Kang, Wei, 88
Kapolka, Daphne, 63
Karunasiri, Gamani, 29, 30, 55, 56, 59
Kendall, Anthony, 81
Knopf, Jeffrey, 117
Kocher, Kathryn, 23
Kölsch, Mathias, 83
Konoske, Paula, 19
Kragh, Frank E., 53, 55, 59, 61
Kress, Moshe, 87
Kwon, Young W., 74, 77

L

Larrazza, Andres, 30
Lavoy, Peter R., 105, 106
Lawson, Letitia, 109, 119
Levin, Timothy, 37, 38
Leweling, Tara, 100
Lewis, Ira, 18
Lewis, Theodore, 81
Lin, Kyle Y., 35, 88
Lober, George, 45, 49
Looney, Robert E., 109, 111, 115
Lucas, Thomas W., 86, 88, 92

M

Maheu, Stafford, LTC, USA, 92
Maier, William B., 30
Malley, Michael S., 106, 107, 112
Mallory, Linda D., 69, 70
Martell, Craig H., 40
Marvel, Orin, 67, 101
McCaffery, Jerry L., 19
McCormick, Gordon, 45, 49
McCutcheon, Wendy J., 43
McEachen, John C., 3, 7, 53, 55, 58, 60
McNelley, Terry, 77
Mehay, Stephen L., 23
Melese, Francois, 15
Michael, J. Bret, 29, 30, 55, 56, 59
Michael, Sherif N., 54
Miller, Alice L., 107, 112
Miller, Steven R., 89
Millsaps, Knox T., 73
Mislick, Gregory K., 89
Moran, Daniel J., 106, 108, 110
Mutty, John E., 12, 17, 21

N

Naegle, Bradley R., 97
Nguyen, Thuy, 41

Norbraten, Terry, 82
Nuss, Wendell, 40, 93
Nussbaum, Daniel A., 21, 34, 89

O

O'Connell, Robert, 51
Olsen, Edward A., 115
Olwell, David H., 33, 34
Oros, Carl, LtCol, USMC, 99, 102
Owen, Walter E., 97

P

Pace, Phillip E., 30, 59
Papoulias, Fotis, 73
Pfeiffer, Karl D., 67, 79, 100, 101
Piombo, Jessica R., 107, 111, 112, 116
Porch, Douglas, 108
Posadas, Sergio, 92

R

Ramp, Steven, 94
Rasmussen, Craig W., 27
Regnier, Eva, 92
Rendon, Rene G., 14, 16, 22
Rice, Joseph A., 31
Richter, Anke, 19
Roberts, Nancy, 50
Robertson, R. Clark, 53, 54, 55, 57, 59
Rosenfeld, Leslie K., 94
Ross, I. Michael, 75, 88
Rothstein, Hy S., 46, 48, 65
Rowe, Neil C., 40, 93
Royset, Johannes O., 85
Russell, James A., 108, 110

S

San Miguel, Joseph G., 15, 18
Sanchez, Susan M., 89, 90
Sekhavat, Pooya, 75
Shaw, William J., 93
Shen, Yu-Chu, 72
Shing, Mantak, 39
Simon, Cary A., 11, 13, 14, 17, 20
Simons, Anna, 47
Singh, Gurminder, 86
Squire, Kevin M., 40
Stanton, Timothy P., 93
Su, Weilan, 7, 53, 58
Summers, Donald E., 18, 23
Swaminathan, Srinivasan, 77
Szechtman, Roberto, 91

T

Thomas, Joseph J., 69
Thompson, Michael, 83

ADVISOR INDEX

Timm, Howard, 15
Trinkunas, Harold, 114, 115
Tucker, David, 48
Tudor, Ron, 15
Tummala, Murali, 5, 7, 29, 30, 55, 56, 58, 59, 60
Twomey, Christopher P., 112

V

Vaidyanathan, Ravi, 57
Vidas, Tim, 37
Vu, Tuong, 116, 120

W

Walker, T. Owens, CDR, USN, 55, 56
Walters, Donald L., 95

Wang, Qing, 79
Weatherford, Todd, 54
Weekley, Jeff, 82
Whitaker, Lyn R., 33, 85, 86, 90
Wirtz, James, 113
Wood, R. Kevin, 91

X

Xie, Geoffrey, 38, 39

Y

Yoder, E. Cory, 43
Yun, Xiaoping, 58, 60, 61

Z

Zolin, Roxanne, 16

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