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RESEARCH

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THE NAVAL POSTGRADUATE SCHOOL'S DEPARTMENT OF METEOROLOGY ADDRESSES THE CRITICAL ROLE OF ATMOSPHERIC SCIENCES FOR SEA POWER 21 AND NATIONAL SECURITY

Professor Carlyle H. Wash
Chair, Department of Meteorology

Introduction

The Naval Postgraduate School's Department of Meteorology is internationally recognized for its outstanding record of research and instruction. Perhaps less known is the important role the Department is playing in addressing and solving key meteorological challenges facing the Department of Navy and Department of Defense. The mastery of the Battlespace Atmospheric Environment is a necessary component for the successful implementation of SEA POWER 21. This article presents a review of some of the unique and valuable efforts undertaken by the faculty and students within the Department in support of SEA POWER 21.

As you read of the research profiled, consider the diverse ways atmospheric processes and phenomena impact military and naval operations. Weather challenges take on many forms as our military defends our nation. The impact of major storms on military operations is well known. In December 1944 during World War II,

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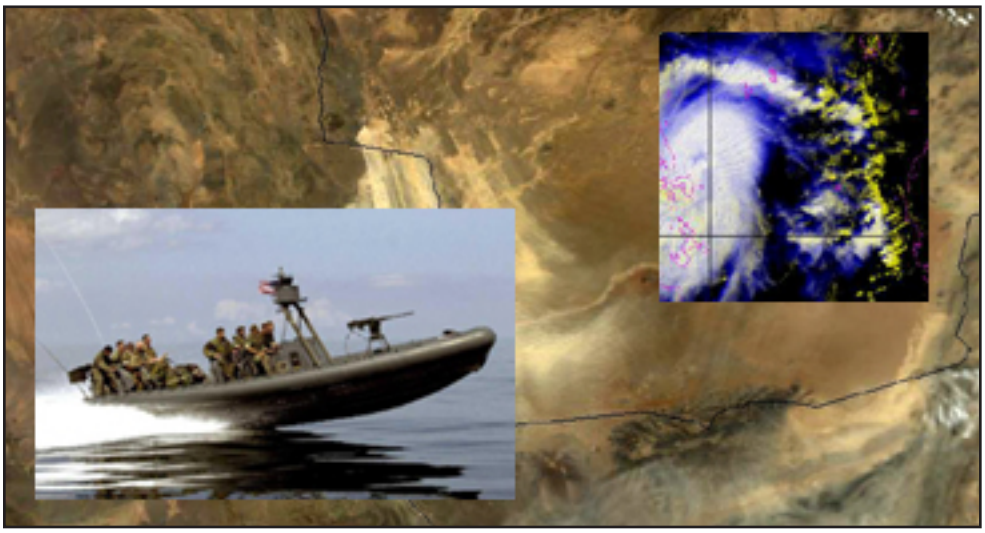

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METEOROLOGY RESEARCH

METEOROLOGICAL REQUIREMENTS AND CONTRIBUTIONS TO 'SEA STRIKE'

Target Area Weather

Weather at the target is a critical component of Sea Strike. Wind, visibility, and cloud conditions impact type of attack weapons and mode of attack. The challenge is how these data may be determined to support Sea Strike in near real-time. **Professor Phil Durkee**, **Research Associate Kurt Nielsen,** and students have been developing new approaches to provide weather support for strike operations using both unclassified and classified remotely sensing data. This classified project effort, called Target Area METOC, has been transitioned and was used for operational support of Operation Iraqi Freedom (OIF). Figure 1 illustrates the satellite view of dust plumes over Afghanistan during Operation Enduring Freedom (OEF), providing an illustration of the type

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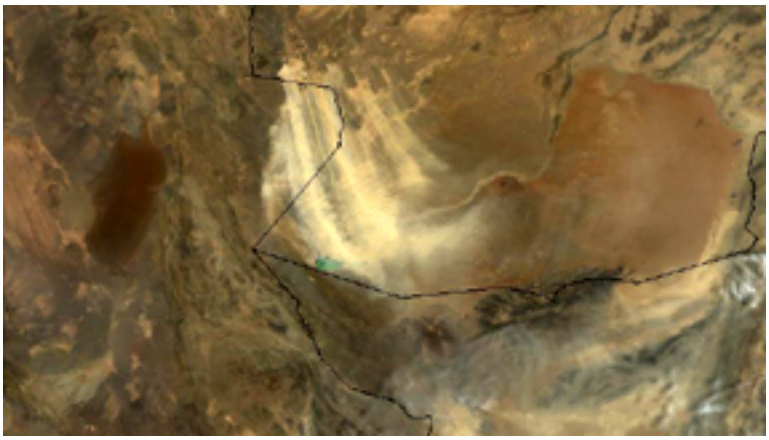

Figure 1. High-resolution visual satellite data depicts plumes of dust over Afghanistan during Operation Enduring Freedom.

METEOROLOGY ADDRESSES CRITICAL ROLE OF ATMOSPHERIC SCIENCES, *continued from page 1*

Typhoon Cobra struck the Pacific Fleet, operating in support of the invasion of the Philippines. Three ships were lost with practically all hands, 28 other ships sustained serious damage and 790 officers and sailors were lost. During the same year, military planners found weather, ocean and tidal conditions were the key elements in determining the day and time of the largest amphibious operation in history, the Normandy D-Day invasion. In the recent Operation Iraqi Freedom, the fierce sandstorm of March 25-27 brought military operations to a near standstill.

Today's modern warfare is also impacted in other less-known, but no less important, ways. Turbulence in the atmosphere impacts laser propagation and modes of communication. Atmospheric aerosols, dust, and sand impact slant-range visibility forecasts for laser-guided weapons, and atmospheric effects can severely impact operation of search and targeting radars. Local wind and turbulence conditions near the surface are the key factor in the dispersion of plumes of hazardous material and the forecast impact of weapons of mass destruction. The Department has valuable and productive research projects addressing these and other critical problems. The ability of the Department to conduct the necessary basic research and then apply these results to specific defense problems underscores its unique and valuable role within the Naval Postgraduate School's support of the Department of Navy and Department of Defense.

LARGE INCREASE OF AIR FORCE STUDENTS FOR NPS METEOROLOGY

In 2002 the Secretaries of the Air Force and Navy ordered a review of residence graduate education programs at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio and the Naval Postgraduate School (NPS). The goals of this review were to ensure officers continue to receive high quality, relevant, and responsive graduate education aligned to defense needs, eliminate unnecessary duplication, and ensure efficient operation of both institutions while maintaining each as "world class" centers of higher education.

One of the results of this review was the transfer of the resident Air Force Master of Science (MS) Meteorology program to NPS. Additionally, NPS is receiving students for the entry level Basic Meteorology Program (BMP). Sixteen Air Force meteorologists arrived for the 2003 Fall Quarter to start a six quarter MS program. Also, 14 Air Force officers are enrolled in the BMP program. These students join 38 Navy Meteorology and Oceanography officers and several foreign students in the Department's courses and labs. The NPS Department of Meteorology is the global leader in military meteorology education and research. Air Force, Navy and foreign students forge strong friendships and trust during the challenges of graduate education that will serve them and the country well in future joint operations and activities.

METEOROLOGICAL REQUIREMENTS AND CONTRIBUTIONS TO 'SEA STRIKE', *continued from page 2*

of high-resolution real-time data valuable for Sea Strike.

An example of some of the work completed is in the Master of Science thesis of **LCDR Nick Vincent, USN**. LCDR Vincent used surface roughness and variability measures from remotely sensed data to characterize atmospheric visibility using various types of unclassified and classified satellite data. These products will enhance the analyses and forecasts of slant-range visibility, which is a key variable for the pilot attempting to successfully put "bombs on target." In other work underway supported by SPAWAR, **Professor Durkee and Research Associate Mary Jordan** use satellite data to determine marine boundary layer conditions related to radar refraction from quantitative analysis of cloud and surface thermodynamic properties.

Figure 2. High-speed boat used for coastal operations.

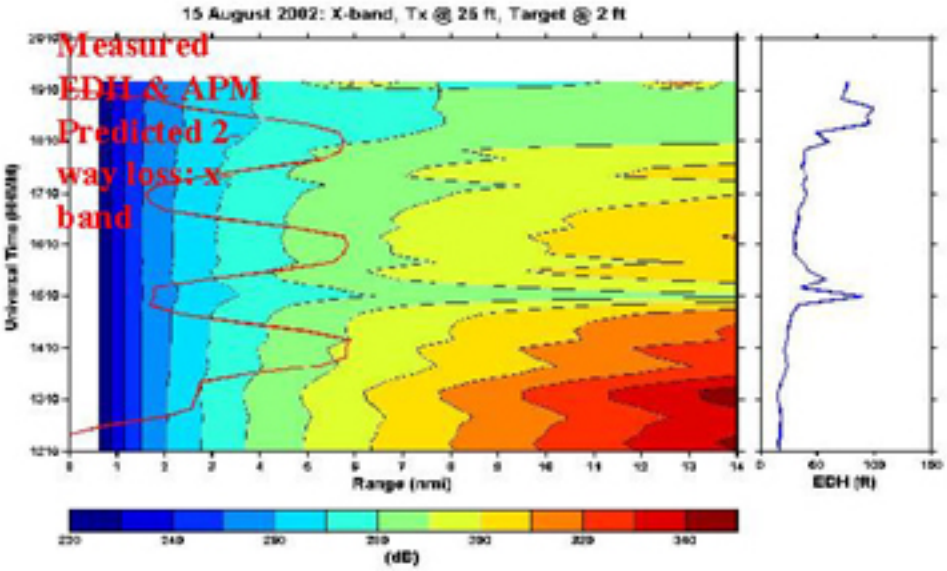

Figure 3. Variations in propagation of search radars in the coastal zone due to atmospheric effects.

Covert Coastal Special Operations

Professor Ken Davidson and **Research Associate Paul Frederickson** have been tackling a Covert Sea Strike problem from the Special Operations community. The SEALS needed to understand the day-to-day and hour-to-hour variations in the propagation from surface search radars, and thus detectability of small combatant craft (Figure 2). An example of these variations is given in Figure 3. Detailed continuous measurements and modeling completed by Professor Davidson, Frederickson, and their students have revealed that temperature and moisture structure of the lowest layer of the atmosphere can explain this behavior. These results, found in the classified thesis work of **LT Dave Kuehn, USN**, point the way for new tactical decision aids and software so that the SEALS can determine the detectability of their combatant craft before and during the mission, which will add new approaches for using the environment battlespace when it may cloak their operations, and understand periods of vulnerability when atmospheric conditions are not favorable for coastal strike operations. The Office of Naval Research, SPAWAR, and the Naval Surface Warfare Center – Carderock, support this work.

Forecast Metrics for Warfare

Senior Lecturer Tom Murphree and **Professor Carlyle Wash** have advised several theses on METOC impacts on naval aviation and surface ship operations. These studies used accident reports to characterize environmental conditions that are most hazardous to

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METEOROLOGICAL REQUIREMENTS AND CONTRIBUTIONS TO 'SEA STRIKE', *continued from page 3*

naval operations, and then made recommendations for mitigating those hazards. This work has led to funding for a new project to develop and apply metrics that quantify the performance and operational impacts of METOC products on strike operations. Major goals of this work include developing quantitative measures of: (1) the impacts of environmental phenomena on mission planning and effectiveness; (2) the quality of forecast information provided to operators; and (3) the impacts of that information on the planning and conduct of operations.

In the project's initial phases, Professor Murphree and students will focus on developing metrics using data from Operation Iraq Freedom (OIF). Later phases will analyze data from other recent strike operations (e.g., Operation Enduring Freedom, Kosovo) and will model the impacts of METOC information on strike operations. An early result from the thesis research of **LCDR Jake Hinz, USNR**, illustrates the impact of the major dust storm of 25-27 March 2003 on OIF aviation operations (Figure 4). Note the large number of canceled sorties (mostly due to weather) in the middle of the storm. Also of interest is the secondary maximum in ineffective sorties flown at the end of the storm.

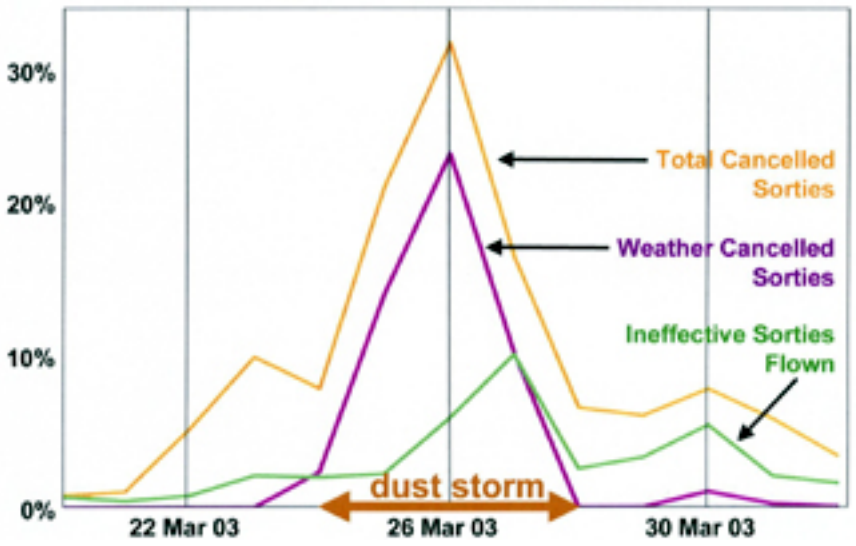

Figure 4. Time series of Canceled, Weather Canceled, and Ineffective Aircraft Sorties during the major sandstorm front of Operation Iraqi Freedom.

Major products from this project will include: (1) low-impact, metrics-based quality control systems for assessing forecast performance and impacts; (2) mission planning aids for improving METOC-related decisions; and (3) scenarios and assessment tools for improving the analysis of METOC impacts (e.g., in OPNAV N70/N81 war games and assessments). This project is being conducted with partners at Systems Planning and Analysis in Arlington, VA, and in collaboration with colleagues at nine Navy operational weather centers, and USAF aviation and weather organizations. The Office of Naval Research and SPAWAR provide funding.

Coastal and Mesoscale Meteorology

Associate Professor Wendell Nuss and associates are studying the important issue of meteorology predictability. Military forecasters use high-resolution forecast models for many applications. They produce future atmospheric scenarios with rich detail and clarity. But will the forecast verify? Professor Nuss's studies have focused on the capabilities of these models and focused on determining the skill level of these forecasts.

MONTEREY, THE PREMIER LOCATION FOR MILITARY METEOROLOGY

The Department of Meteorology's history dates back to the 1930s when it was part of the Postgraduate Department of the U.S. Naval Academy. After the move to Monterey, the Navy decided to locate its new operational numerical weather prediction unit (now Fleet Numerical Meteorology and Oceanography Center (FNMOC)) on the NPS campus. Next, the Navy's atmospheric research lab (now Naval Research Lab – Monterey) was moved from Norfolk to collocate with NPS and FNMOC. Both of these organizations are now located at the NPS Annex next to the NPS golf course. Finally, the National Weather Service, recognizing the education and research opportunities at NPS, moved its San Francisco Bay forecast office to the NPS Annex campus as well. Because of these organizations, the Monterey area is recognized internationally for its programs in graduate education, global, regional and local modeling, and military meteorology research. In acknowledgment of the outstanding NPS research and graduate degree programs, the NPS Departments of Meteorology and Oceanography were invited to join the University Corporation for Atmospheric Research in 1991.

ROLE OF WEATHER IN 'SEA BASING' AND DOMINANT MANEUVER

Sea Base Tropical Cyclone Threat

It has long been recognized that tropical cyclones are a formidable foe when planning ocean transit and sea basing. Accurate forecasts are essential for fleet safety and also to permit effective sorties of the fleet from ports to escape tropical cyclone landfall. The losses from Typhoon Cobra initiated the formation of a forecasting center for typhoons that now is called the Joint Typhoon Warning Center (JTWC) and is located in Pearl Harbor, HI. **Distinguished Professor Russ Elsberry**, **Associate Professor Pat Harr**, and **Research Assistant Professor Cheung** with **Mark Boothe** and their students have focused their research on the improvement of tropical cyclone track and intensity predictions, as well as extending the range of the forecasts from three to five days.

Professor Elsberry and Dr. Lester Carr, now at Computer Sciences Corporation, developed a new approach for forecasters to improve their interpretation and use of numerical model tropical cyclone forecasts. This technique, called the Systematic Approach to Tropical Cyclone Track Forecasting, was transitioned to JTWC in 1999 and has been extremely successful. Figure 5 presents a plot of annual 72-h forecast track errors from 1990 to 2002.

Note that JTWC has established new records for low track errors the last four years using this technique. The track error from 2002 was 163 n mi, which approached the CINCPACFLT goal of 150 n mi established in 1984. This system is now being tested at the NOAA National Hurricane Center in Miami, FL, as well. NPS tropical cyclone research is now expanded to address the issue of intensity and also to extend the range of the forecasts to five days, which will further enhance the value of this METOC product. Professor Harr and students have addressed the ending stage of a tropical cyclone at sea when it transforms into a vigorous rapidly moving mid-latitude storm. Because optimum ship routes may shift poleward during the summer, these post-tropical cyclones that have moved into the midlatitudes can severely impact shipping lanes and fleet transit. Harr and PhD graduate, **LCDR Pete Klein, USN**, developed a model of this complex process that assists JTWC forecasters in addressing this stage of the storm's life. The Office of Naval Research and SPAWAR have supported this work.

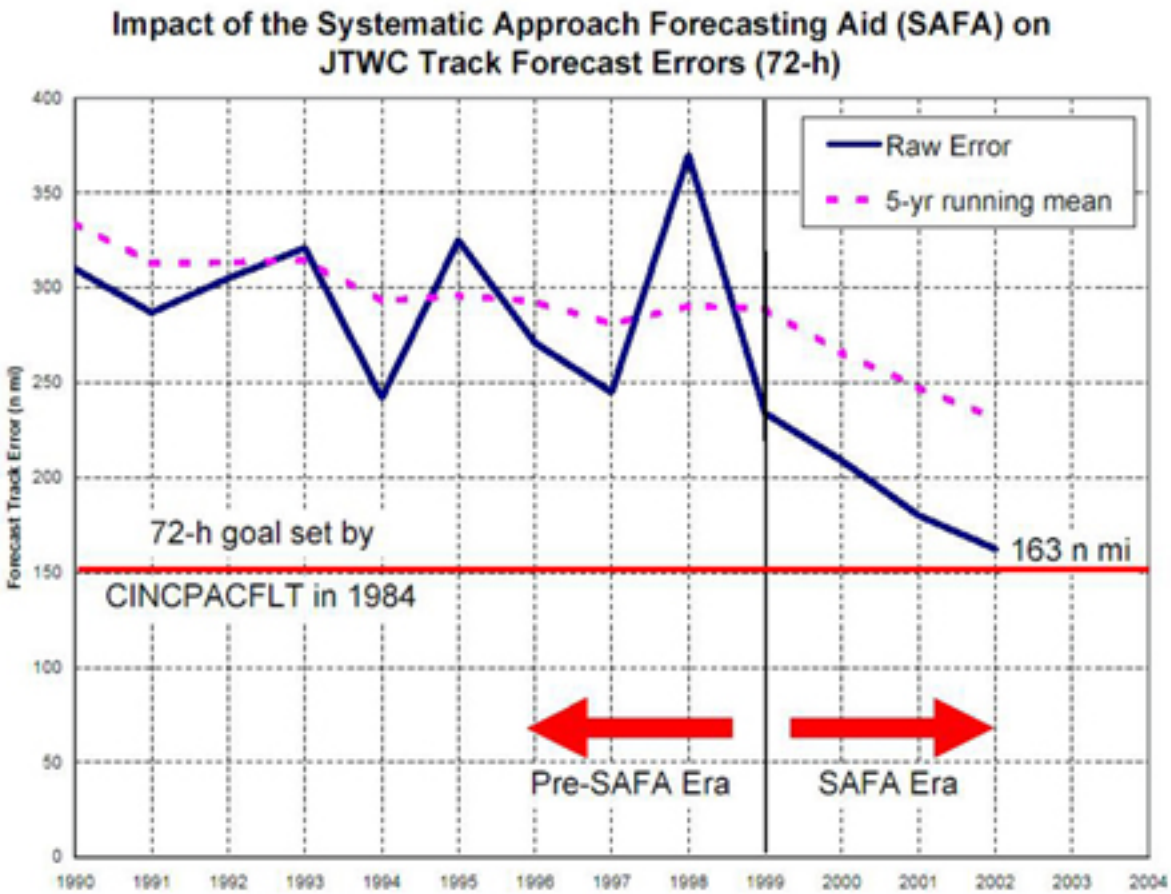

Figure 5. Annual JTWC Tropical Cyclone Track Error from 1990 to 2002. Note recent improvement with implementation of Systematic Approach technique.

Threat to Sea Lanes from Tropical Cyclones

Another example of the impact of Department of Meteorology

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ATMOSPHERIC IMPACTS ON 'SEA SHIELD'

Forecasting Turbulence for DoD
Atmospheric turbulence adversely impacts the intensity of lasers as they propagate through the atmosphere. The use of lasers for targeting and missile defense demands that real-time analyses and forecasts of atmospheric turbulence be developed to support the communication and missile self-defense components of Sea Shield. Understanding of the weather conditions favorable for generating significant atmospheric turbulence is incomplete since it often occurs on rather short time scales and on small spatial scales, making its occurrence difficult to observe and predict.

Research Associate Professor Doug Miller and **Professor Don Walters** of the Physics Department have completed extremely

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USING RAPID ENVIRONMENTAL ASSESSMENT TO IMPROVE THE HAZARD PREDICTION AND ASSESSMENT CAPABILITY FOR WEAPONS OF MASS DESTRUCTION

LCDR Victor Ross, United States Navy
Master of Science in Meteorology and Physical Oceanography and Master of Science in Computer Science – December 2003
Advisors: Professor Carlyle Wash, Department of Meteorology, and Professor Neil Rowe, Department of Computer Science

The Oceanographer of the Navy is responsible for the environmental data portion of the "4-D cube." This is a new concept that creates a Virtual Natural Environment that must be capable of rapid environmental updates. This research investigates using in situ atmospheric measurements to improve the performance of the Navy mesoscale model, Coupled Ocean-Atmosphere Mesoscale Prediction System. These enhanced, operational model forecasts are used to supply atmospheric forcing to a dispersion model, the Hazard Prediction and Assessment Capability, and the outcome is evaluated to determine the impact of the additional data.

WEATHER IN 'SEA BASING' AND DOMINANT MANEUVER, *continued from page 5*

tropical meteorological research is the internationally recognized study of the development of Typhoon Vamei in 2001 by **Distinguished Professor C. P. Chang** and collaborators. Vamei genesis was near Singapore so close to the equator its development could not be explained by the conventional theory of tropical cyclone formation. This storm, shown in Figure 6, impacted the Carrier Vinson battlegroup as it returned from Operation Enduring Freedom.

Professor Chang and his co-authors explained how this storm developed and provided estimates of how often this rare event would happen in the future. His papers on this cyclone received worldwide recognition. The understanding of storm development in the equatorial South Chine Sea, an area of several critical sea-lanes, is critical to sea basing and maneuver of Navy battlegroups. Professor Chang's work on monsoon circulations and other weather phenomena of the Asian continent have been very valuable in supporting military operations near Korea, Philippines, Indonesia, Malaysia, Pakistan, and other locations in Eastern and Central Asia.

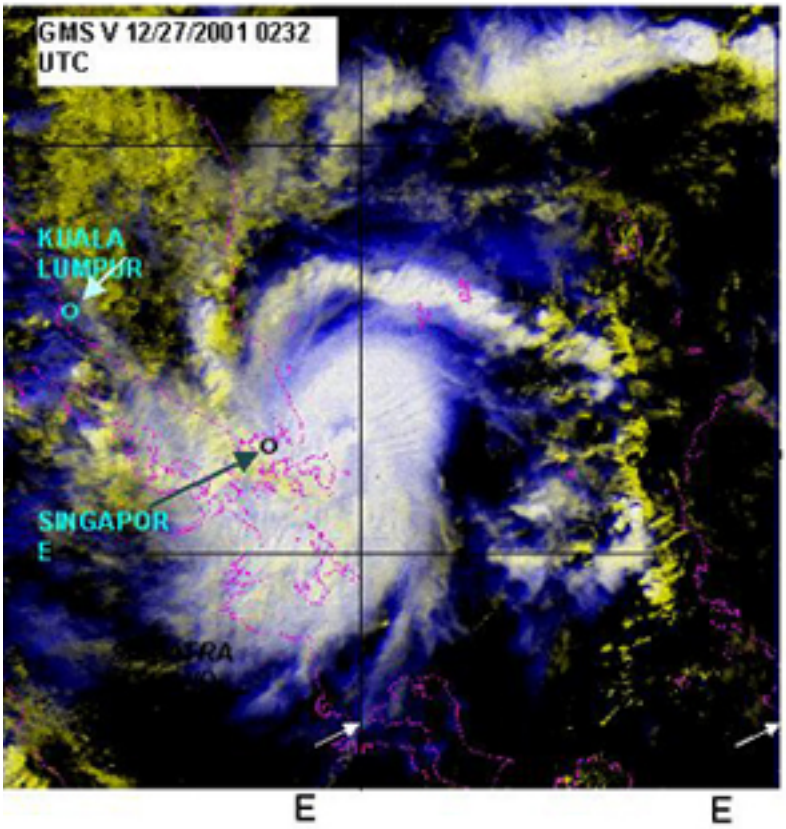

Figure 6. Tropical Cyclone Vamei near Singapore.

NPS FIELD EXPERIMENTATION PROGRAM PROVIDES UNIQUE OPPORTUNITY FOR STUDENTS AND FACULTY

In FY 2002 NPS initiated a field experimentation program to provide students and faculty the opportunity to utilize and evaluate their latest technologies in an operational environment while at the same time permitting operational forces the opportunity to experiment with these technologies. The program was initiated, and NPS' participation continues to be made possible, through utilization of Congressional support to our Center for Defense Technology and Education for the Military Services (CDTEMS). The initial program (Butner, *NPS Research*, February 2003 Special Edition, p. 27) was directed at utilization of unmanned aerial vehicles (UAVs) to enhance the ability of SEALs conducting downed pilot rescue. The program rapidly grew and increased in op tempo when it was coupled with the Surveillance and Target Acquisition Network (STAN) effort in January 2003 (Manuel, *NPS Research*, June 2003, p. 14). Three major experiments have been conducted with STAN (July, September, and October) and a fourth will be conducted at Camp Roberts, CA from 19-27 February 2004. The focus of these experiments has, to date, been on tactical operations; that is push and pull of data, voice, and video for improved situational awareness and warfighter effectiveness of the operator on the ground or in the water. Compatibility with theater and national capabilities is a consideration, but their utilization has not been a major focus.

While NPS has a substantial research program with evolving technologies that are ready for field demonstration, we obviously do not have a corner on this market, nor do we have the ability to very rapidly build and deploy many of these technologies. Which technologies are ready for field demonstration depends not only upon the maturity of the S&T but also on the requirements of operational forces. For this reason, STAN currently involves a very interactive team consisting of a requirements sponsor (U.S. Special Operations Command (SOCOM)), defense contractors (Sierra Nevada Corporation, AKSI Solutions, Inter-4, and eTreppid), and students, staff, and faculty at the Naval Postgraduate School. The participation of the defense contractors is made possible through support from SOCOM. This combination of participants and funding sources provides our students and faculty the ability to experience the full range of activities associated with bringing a new technology to the point where it can be utilized by operational forces; from delineation of requirements through field experimentation and data analysis. It involves the interaction of modeling and simulation with experimentation, data collection and analysis, and the generation of quantitative measures of performance of both the technologies and the operators utilizing these technologies. We selected an op tempo of one experiment per quarter in order to facilitate both the needs of SOCOM and the quarterly academic schedule of NPS, thereby permitting the maximum participation of our students through thesis research and class projects. The high op tempo is not without some difficulties. By the time a typical final report is written the results are often obsolete; changes having been rapidly made to correct and improve on the results from the just-completed experiment for the next experiment.

This combination of participants and funding sources provides our students and faculty the ability to experience the full range of activities associated with bringing a new technology to the point where it can be utilized by operational forces...

The constitution of the team also provides another unique opportunity; effectively dealing with the somewhat different major objective of each component. SOCOM is primarily interested in delivering new and innovative products to the warfighter in the very near future, the defense contractors are primarily interested in getting their products to the point where they can be demonstrated to meet the specified requirements, and NPS has a primary focus of conducting experiments with new and emerging technologies in which the data support quantitative measures of performance. This is not to say that all three components of the team are not actively interested and involved in the major objectives of the other team members, they are. However, it does mean the regular planning meetings require compromises to be made between all three important major areas if an effective activity (experimentation and demonstration) is to be accomplished in the 7-9 days scheduled each quarter.

Significant progress has been made in a very short time. With the first STAN experiment being conducted in July 2003, there has already been operational use of one of the technologies utilized. Two more have promise for use in early 2004. The original goals for STAN have been significantly expanded. A maritime component has been added to provide

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NPS FIELD EXPERIMENTATION PROGRAM PROVIDES UNIQUE OPPORTUNITY FOR STUDENTS AND FACULTY, *continued from page 7*

a common operational picture for underwater, surface and air. In addition, new technologies for mobile networks (self-forming/self-healing, cooperative control/interaction of multiple unmanned vehicles, etc.), sensors controlled over the network, and unmanned ground vehicles have been added. Some of the latest capabilities developed by students and faculty are also being phased into the series of experiments: network vulnerability assessment using the Information Science Department NEMESIS van (*NPS Research*, February 2003 Special Edition, p.2), network performance monitoring, auto-landing of UAVs on ships, coupled electronic warfare and UAV avionics for target ID and direction finding, network security, precision target location, cognitive blending for prediction of "red team intent," detection of concealed weapons, human systems performance, and maritime domain awareness.

At the present time there are eleven thesis students, sixteen faculty, and four staff involved in the program from seven departments, two Research Centers, and two Research and Education Institutes. In addition, the departments of Defense Analysis, Operations Research, Information Science, and Systems Engineering are utilizing the program for class projects, providing benefit to the operational content of the classroom instruction and to the support required for the field experimentation.

Some of the components of the experiments (802.11b network, eTreppid compression, etc.) have been developed and demonstrated to the point that they will not be substantially changed in the February 2004 experiment. While some improvements are always being evaluated, they are being used

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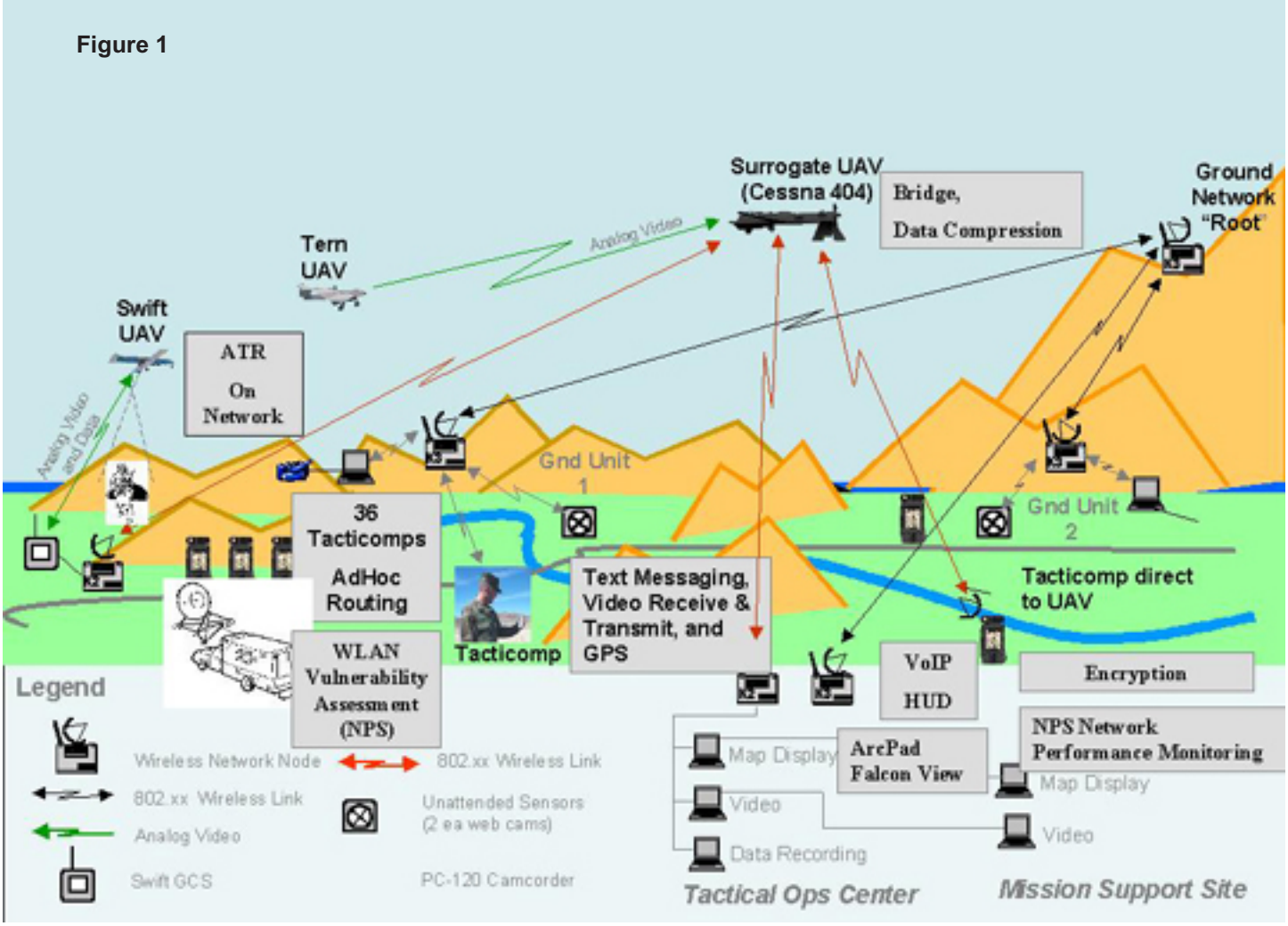
Figure 1

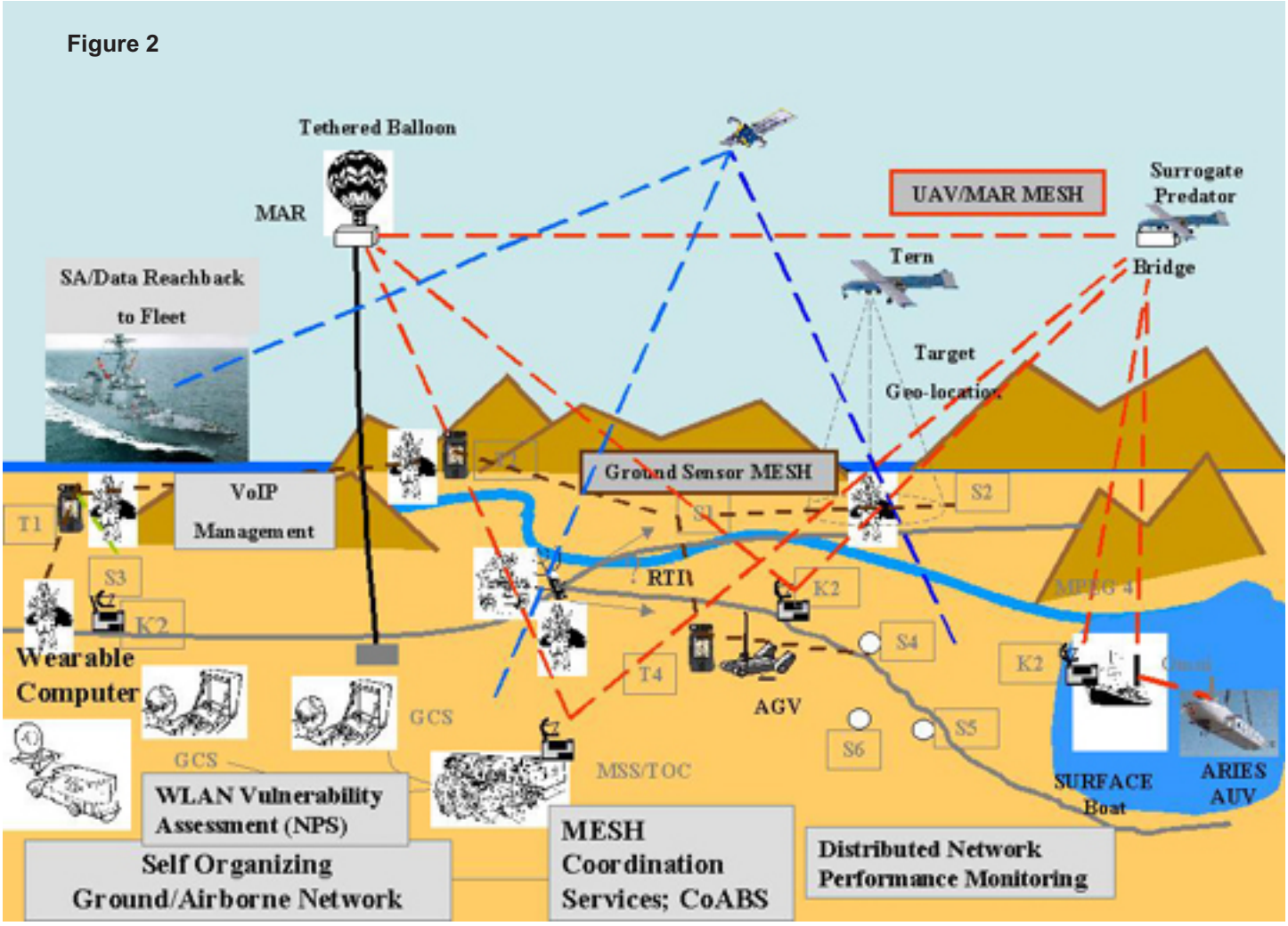


NPS FIELD EXPERIMENTATION PROGRAM PROVIDES UNIQUE OPPORTUNITY FOR STUDENTS AND FACULTY, *continued from page 8*

as the backbone for experimentation with emerging new technologies. For this reason it was decided to split the network into two components for this experiment; the "backbone" networks developed by SNC/AKSI and an experimental network being utilized by NPS. Each is involved with both networks and network integration will be attempted as new components become reliable and demonstrate their utility for the operator. The components of the Contractor Team (supported by NPS) network and experimentation for February 2004 are delineated in Figure 1 and have a major focus on network operational reliability and utilizing the networks with a large number of small, hand-held Tacticomps for text messaging, video receive and transmit, VoIP, HUD, and GPS. The components of the NPS (supported by the Contractor Team) network and experimentation for February 2004 are delineated in Figure 2, and have several new areas being investigated: self organizing ground/airborne network, utilization of autonomous underwater vehicles with UAVs, a tethered balloon with a mobile access router, VoIP management, wearable computers, various sensors operating over the network, and reach-back of situational awareness/data reach-back to the Fleet. The sensors being utilized on the network include seismic/acoustic, new EO and IR video camera technologies, cameras on a UGV, laser range finder with coupled camera, and muzzle flash detection.

The NPS field experimentation program continues to evolve with new technologies as we attempt to improve the entire process both for improved results and collaboration with other government and industry programs as well as for the educational experience of our students.

Figure 2



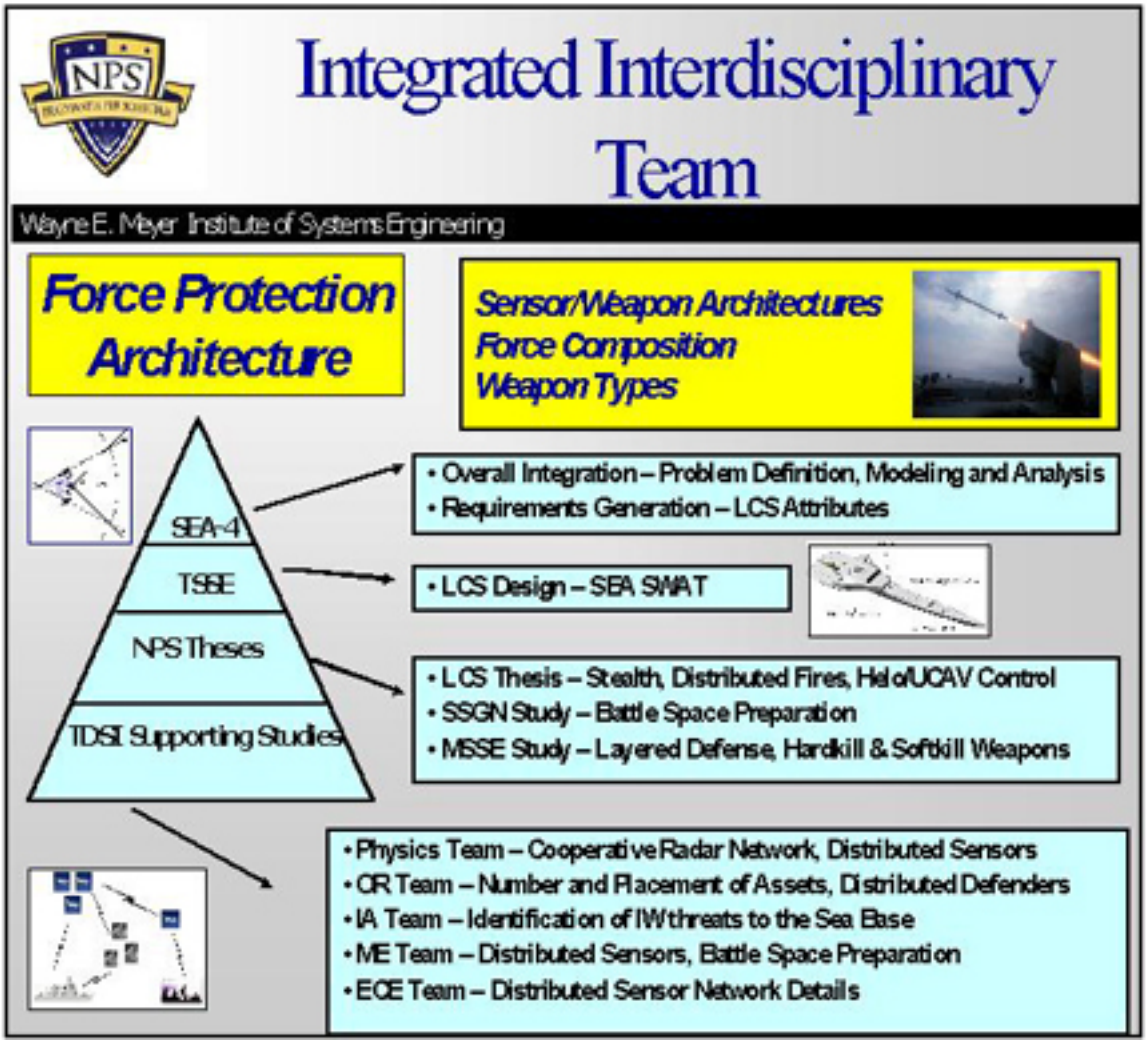
EXPEDITIONARY WARFARE FORCE PROTECTION

Captain Jeffrey Kline, United States Navy
Lieutenant Chris Wells, United States Navy

On 4 December students from the Naval Postgraduate School's Systems Engineering and Analysis (SEA) curriculum presented a system of systems conceptual solution for expeditionary warfare force protection. The SEA students presented findings from a 2003 integrated project that represented the combined efforts of approximately 60 students and 15 faculty members from different NPS departments.

The first phase of the study began in 2002. The 2002 study identified and defined capability gaps, developed platform solutions, and generated conceptual design requirements for an expeditionary warfare family of ships, a heavy lift aircraft, and other systems designed to be capable of fully implementing the Ship-to-Objective-Maneuver and Sea Basing doctrines identified as the future concepts of operation.

The 2003 Expeditionary Warfare Force Protection Integrated Project developed a system of systems conceptual solution to provide force protection for the conceptual Sea Base developed in the 2002 study. The task was accomplished through the use of a distinct Systems Engineering methodology (defining the problem, creating a scenario, conducting analysis, and using modeling and simulation tools to draw conclusions and determine results). Requirements were determined from initial analyses of expeditionary warfare and force protection. These requirements were then passed to various supporting teams. Supporting studies from individual student theses and student faculty teams, including those from the Temasek Defense Systems Institute, were used as a basis for developing the associated proposed architectures. A breakdown of the teams and brief descriptions of their contributions are shown (see left).



Understanding the complex nature of force protection of the Sea Base required the use of modeling and simulation tools. The tools initially assessed included: Joint Army Navy Uniform Simulation (JANUS), Joint Theater Level Simulation (JTLS), Naval Simulation System (NSS), Enhanced ISSAC (Irreducible Semi-Autonomous Adaptive Combat) Neural Simulation Toolkit (EINSTein), EXTEND, and Microsoft Excel. After completing a detailed risk

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EXPEDITIONARY WARFARE FORCE PROTECTION, *continued from page 10*

analysis, the team decided to include NSS, EINSTein, EXTEND, and Microsoft Excel as parts of the study.

In order to adequately determine the relative performance of the proposed architectures developed by the team, a thorough and systematic design of experiments was developed to maximize the model runs. The primary characteristics of the proposed architectures are force composition, sensor and weapons architecture, and weapon types. Using a 2^n factorial design, two levels of each characteristic were developed. The force composition levels are courses of action (COA) A and B. COA A (Figure 1) is a CRUDES-based protection force comprised of three CGs (Guided Missile Cruisers), three DDGs (Guided Missile Destroyers), three FFGs (Guided Missile Frigates), and one SSN (Fast Attack Submarine). COA B (Figure 2) is a Littoral Combat Ship (LCS)-based protection force comprised of one CG, one DDG, 12 LCS, and one SSN.

The sensor and weapons architectures are point and distributed. Weapon types are current and conceptual. Figure 3 is representative of the proposed distributed architecture.

From the functional analysis, survivability was determined to be the key function in force protection of the Sea Base. The primary measure of effectiveness (MOE) of protecting the Sea Base, therefore, was determined to be the survivability of the Sea Base and its transport assets. The output of each of the models was designed to facilitate the collection of information needed to determine the survivability of the Sea Base and its transport assets. The key findings of the study were:

- The distributed sensor and weapons architectures improve force survivability by providing increased available reaction times and more

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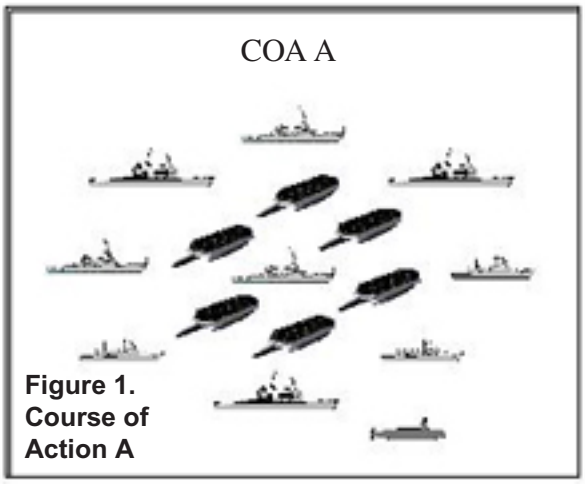

Figure 1. Course of Action A

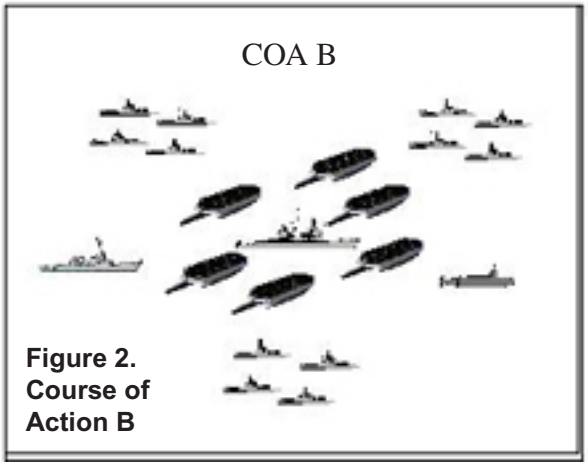

Figure 2. Course of Action B

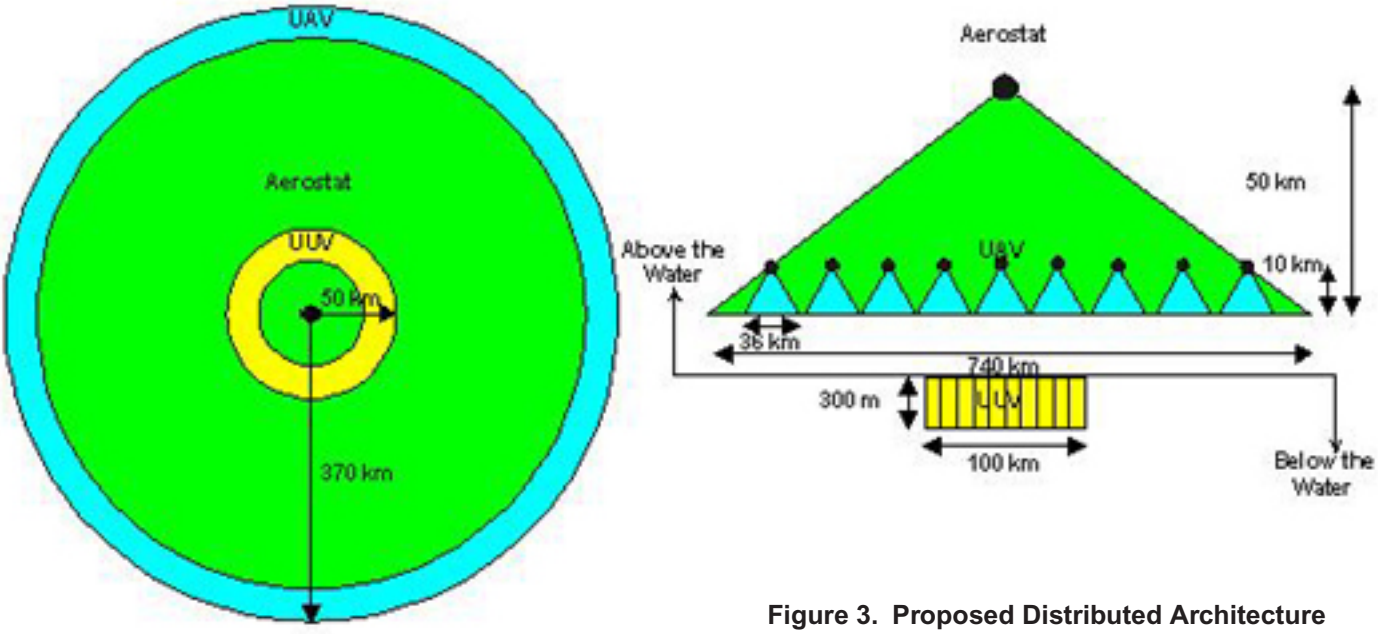

Figure 3. Proposed Distributed Architecture

EXPEDITIONARY WARFARE FORCE PROTECTION, *continued from page 11*

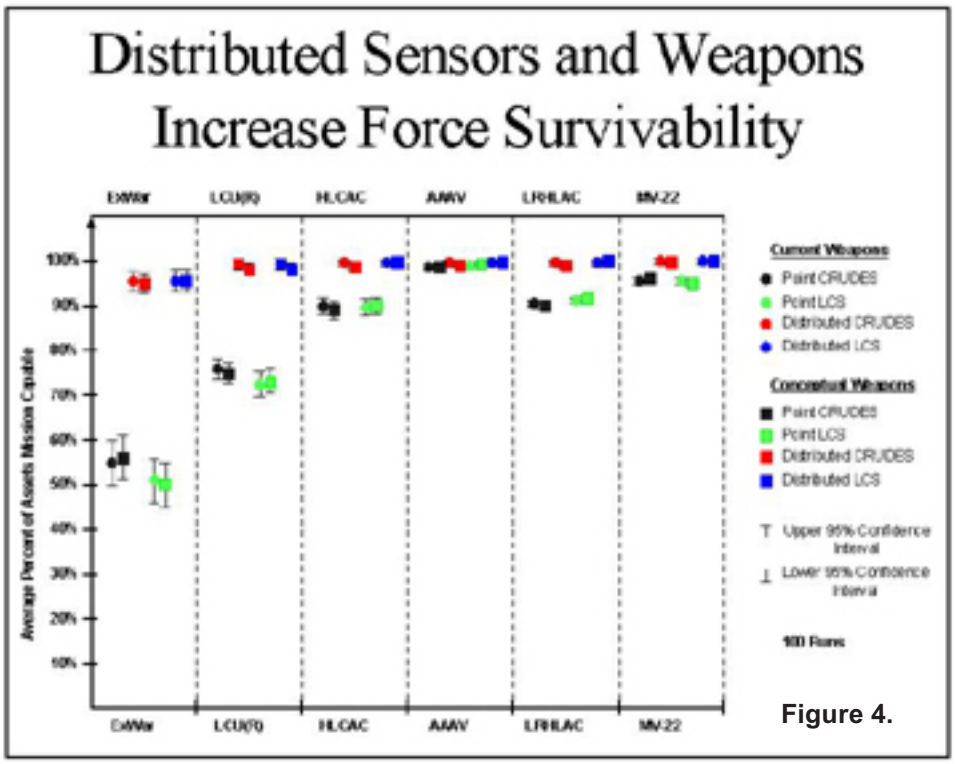

Figure 4.

engagement opportunities. Through the analysis of the EXTEND modeling results, the distributed sensor and weapons architectures were determined to be significantly better than point sensor and weapons architectures in their ability to protect the assets of the Sea Base (Figure 4). These architectures are particularly effective against Undersea Warfare (USW) threats because submarines can be detected and engaged prior to closing within effective torpedo ranges. Limited torpedo defense capabilities were identified as the primary cause of mission kills in the point sensor architecture.

- Conceptual weapons, when paired with distributed sensors, improve survivability by increasing available reaction time. Conceptual weapons included higher-speed, longer-range

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FIRST TEMASEK DEFENSE SYSTEMS INSTITUTE (TDSI) CLASS GRADUATES

The Temasek Defense Systems Institute (TDSI) is proud to announce the graduation of the first class of the newly created NPS and National University of Singapore (NUS) joint Defense Technology and Systems dual masters degree program. This program was launched in July 2002 under the auspices of the jointly established Temasek Defense Systems Institute based in Singapore, which sponsors graduate education and research in the area of defense technology, systems engineering, and analysis. The joint NPS/NUS curriculum provides a platform for the education and the integration of operational staff and defense technologists to plan, design, develop, create, operate, and sustain Integrated Military Forces of the 21st Century. The first class was comprised of 27 Singaporean students, two U.S. students, and one Israeli student. The students were awarded two master's degrees, one from NUS and the other from NPS.

The first two quarters of the 18-month joint curriculum were conducted at NUS by faculty from NUS and NPS. The ten courses provided a firm grounding in key technical and systems engineering skills. Quarters three through six were conducted at NPS, where the students entered into designated specialization tracks such as Communication Systems, Sensor Systems,

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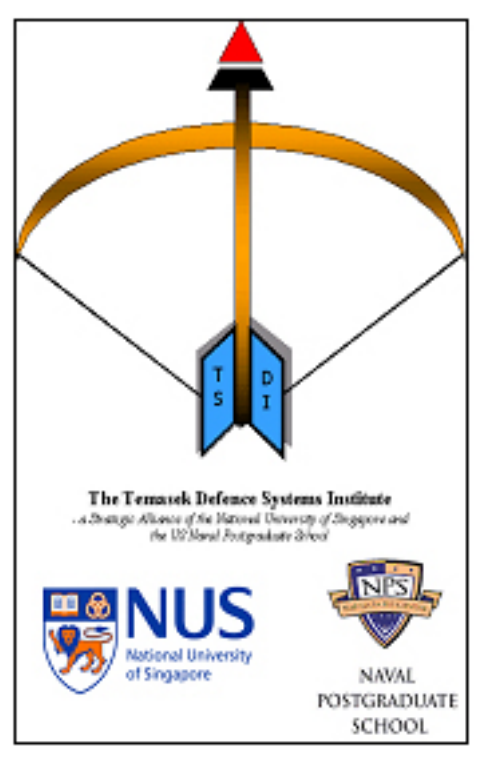


EXPEDITIONARY WARFARE FORCE PROTECTION, *continued from page 12*

variants of existing weapons, and a free-electron laser. Detecting threats at greater ranges provides commanders with more time to evaluate threats before committing weapons.

Systems Engineering and Analysis Students (from left to right): LT Chris Wells, USN, LT Vinc Tionquiao, USN, LCDR Ron Higgs, USN, LCDR Greg Parkins, USN, LCDR Eric Higgins, USN.

- The distributed architecture conserves weapons by detecting targets at ranges close to the maximum range of the interceptor. The longer detection ranges, in conjunction with the increased maximum ranges of the conceptual weapons, allow threat platforms to be engaged before they can launch their weapons. For example, if an aircraft capable of launching four anti-ship cruise missiles is destroyed before launching those missiles, then only one interceptor is used instead of four. Also, the greater reaction time provided by the distributed sensors allows for improved targeting, which contributes to the conservation of weapons.
- The CRUDES (Cruiser-Destroyer)-based and the LCS-based force compositions were tactically equivalent. Ultimately, another measure of effectiveness, such as manning, life cycle costs, etc., would have to be used to select a preferred concept.

Additional findings and details regarding the recommended architecture can be found in the final report and presentation that will be available at http://www.nps.navy.mil/SEA/SeaBaseDefense/.

FIRST TEMASEK DEFENSE SYSTEMS INSTITUTE CLASS GRADUATES, *continued from page 12*

Operations Research, Information Assurance, and Guided Weapon Systems. The students blended their operational experience with a thorough technical education to integrate new technological capabilities into operational applications. An important part of this joint curriculum was participation in the nine-month NPS campus-wide Integrated Project for which the theme was "Defense of the Sea Base." Supervised by NPS faculty from five departments, the innovative TDSI Integrated Projects included a Flapping Wing Micro Air Vehicle (Mechanical Engineering), a Cooperative Radar Network (Physics), a Sea Based Information Systems Protection Plan (Computer Science), Sensor Data Fusion Networking (Electrical and Computer Engineering), and a Sea Based Analytical Model and Project Operational Test and Evaluation Plan (Operations Research).

After their successful completion of the program, the students were awarded a NUS Master of Science Degree in Defense Technology Systems and a NPS Masters of Science Degree in their appropriate technical discipline, which included Electrical Engineering, Computer Science, Mechanical Engineering, Operations Research, and Combat Systems Technology.

APPLICATION OF SEAWEB TECHNOLOGY TO NAVAL SPECIAL WARFARE (NSW)

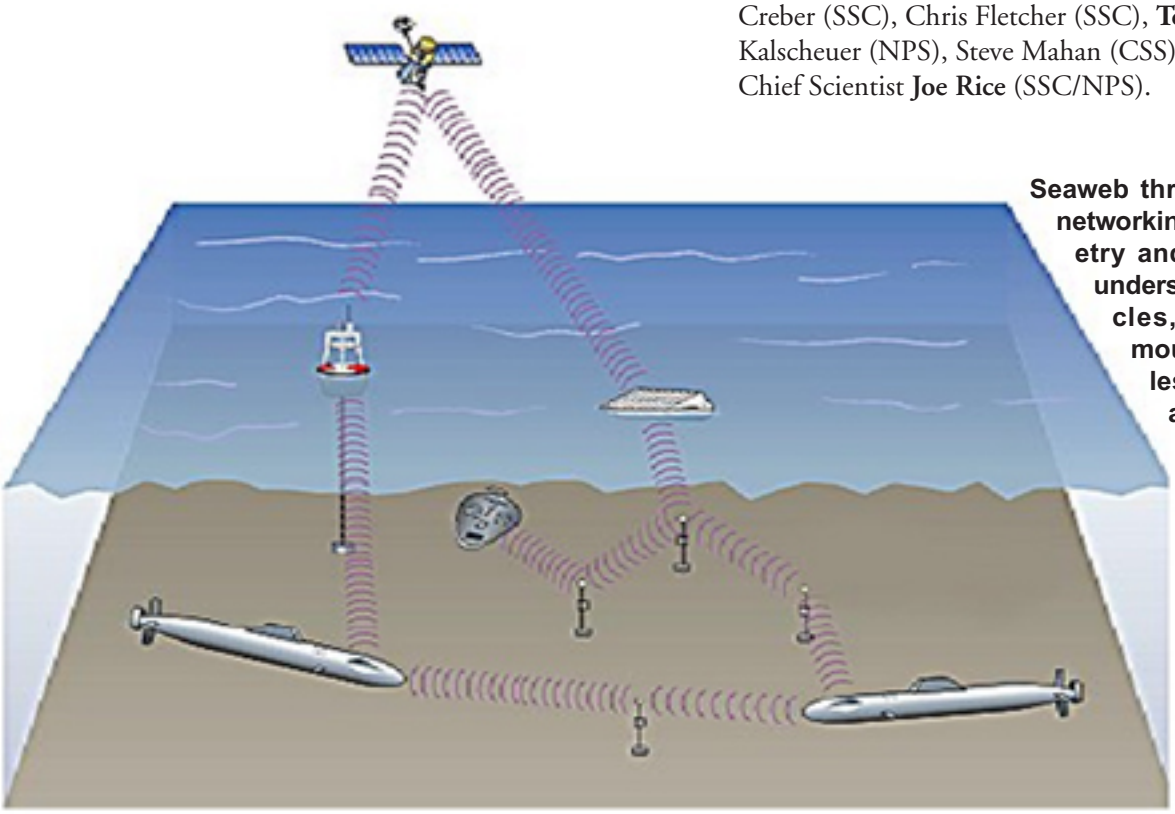
The Seaweb Naval Special Warfare (NSW) 2004 Experiment occurred 10-15 January in St. Andrews Bay, Panama City, FL. This experiment exercised state-of-the-art U.S. Navy Seaweb technology for through-water networked command and control (C2), image telemetry, and node-to-node ranging. The nine-node underwater acoustic network included five telesonar repeater nodes, two moored Racom gateway buoys equipped with FreeWave line-of-sight radio and Iridium satellite radio, and a surface craft equipped with SEAL Delivery Vehicle persicope controller and telesonar deck unit. The wireless network was remotely operated through a Seaweb server aboard the surface craft.

All experiment objectives were met, including demonstration of networked command and control, networked node-to-node ranging, networked chat, and networked data telemetry. The through-water data telemetry involved reconfigurable routing of 1500-byte image files at rates of 1200 and 800 bits/s through multiple network nodes, with node-to-node distances up to 2 km. Reliable communications were achieved through the use of forward-error correction at the physical layer, selective automatic repeat request at the link layer, and end-to-end positive acknowledgment in response to receipt requests at the network layer.

Much of the experiment supported a NPS link-margin study through the recording of received signals and noise, acquisition of water-property data, propagation modeling, and logging of telesonar physical-layer performance as functions of range and transmit power.

The final day of testing was observed by representatives from the Special Warfare Command-Coronado and U.S. Special Operations Command-Tampa, along with managers from the Office of Naval Research (ONR), Coastal Systems Station (CSS), and Benthos. Seaweb is viewed as an enabling technology for the FY05-start Sea Eagle ACTD being advanced by PMS NSW.

This experiment was an FY04 milestone of the Telesonar Technology for Naval Special Warfare project sponsored by the ONR and executed by Naval Postgraduate School Physics Department with involvement by Space and Naval Warfare Systems Center San Diego (SSC) and contractor Benthos, Inc. The experiment was performed in collaboration with the USSOCOM-sponsored, CSS-executed Underwater Master Comms Node project and with the ONR-sponsored, SSC-executed Telesonar Technology for Deployable and Off-board Systems project. Experiment personnel were, in alphabetical order, Paul Baxley (SSC), Mike Coryer (Benthos), Bob Creber (SSC), Chris Fletcher (SSC), **Tom Hofler** (NPS), Jon Kalscheuer (NPS), Steve Mahan (CSS), Bill Marn (SSC), and Chief Scientist **Joe Rice** (SSC/NPS).



Seaweb through-water acoustic networking enables data telemetry and remote control for undersea sensor grids, vehicles, and other autonomous devices. The wireless undersea links are achieved with telesonar signaling and modems. Gateways to manned control centers include submarine sonar adaptations (Sublink) and radio/acoustic communications (Racom) buoys with wireless links to sky or shore.

PROJECT NOTES

SUCCESSFUL DEMONSTRATION OF PLASMA IGNITION FOR PULSE DETONATION ENGINES

Results of an innovative ignition system for pulse detonation engines were reported in January at the annual American Institute of Aeronautics and Astronautics meeting in Reno, Nevada. This interdisciplinary collaborative research effort is supported by the Office of Naval Research. It began as a collaboration with **Distinguished Professor David Netzer** and continues with **Research Associate Professors Jose Sinibaldi** and **Chris Brophy**, Department of Mechanical and Astronautical Engineering at NPS, and **Professor Martin Gundersen** of the University of Southern California, currently a Visiting Professor in Physics at NPS.

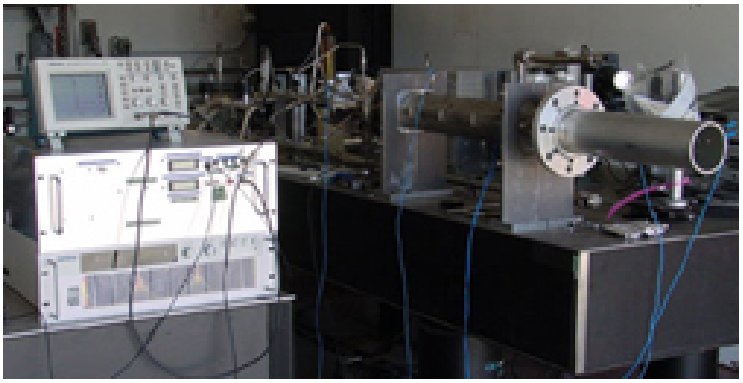


Figure 1. USC pulsed power apparatus (left) and NPS pulse detonation engine (right).

Pulse detonation engines have been under investigation in several countries and laboratories for a variety of applications because of their intrinsically improved efficiencies. A critical issue to the success of such engines is the development of rapid and reliable ignition systems. The work in the Rocket Laboratory at NPS demonstrated proof-of-principle for just such an ignition system.

The transient plasma ignition system was demonstrated to substantially reduce the ignition delay and deflagration-to-detonation transition times for ethylene-air and propane-air mixtures under dynamic fill conditions (Figure 1). The conditions include equivalence ratio, a temperature range of 280K to 430K, flow rates to 0.35kg/m, and pressure range of 1 to 6 atm. In Figure 2, an array of many streamers is shown from the side of a combustion chamber. These streamers persist for approximately 50 nanoseconds. In Figure 3, a transient plasma is shown (top, barely visible) along with an arc (bottom, bright). The streamers produced during approximately 50 nanoseconds with an energy budget comparable to a more traditional 'spark plug' ignition, introduce higher energy electrons that produce more effective combustion species through dissociation and radical production. Spark ignition normally occurs over a few hundred microseconds, that is, during a time that is over

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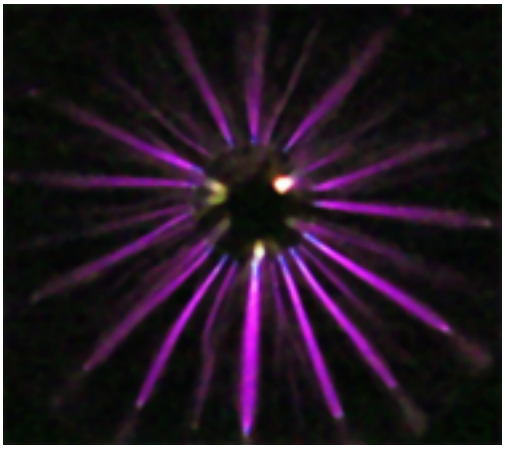

Figure 2. Fluorescence emission during streamer propagation.

(From left to right) Jose Sinibaldi, Gabriel D. Roy (Program Manager for the Office of Naval Research), Long Lee (San Diego State University), Martin Gundersen, Chris Brophy, and Fei Wang, a USC graduate student in Physics, with test apparatus.

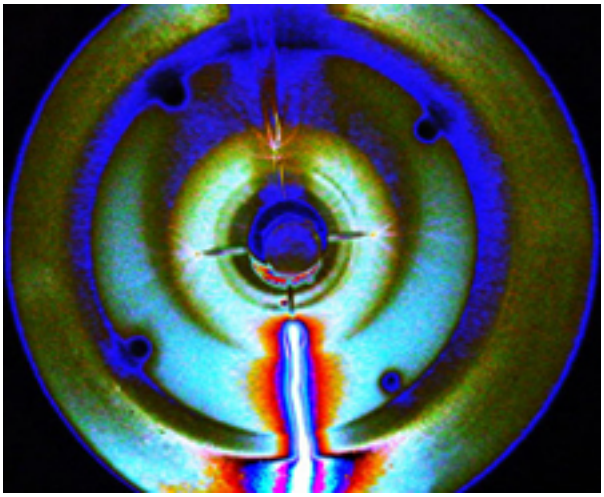

Figure 3. Dual discharge of streamer and arc discharge.

PROJECT NOTES

CENTER FOR INTERDISCIPLINARY REMOTELY PILOTED AIRCRAFT STUDIES SUPPORTS COAST GUARD'S HOMELAND SECURITY EFFORTS

The Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) supported a U.S. Coast Guard (USCG) program to evaluate new ways of delivering Surveillance, Detection, Classification and Identification (SDCI) capabilities. As part of this program, CIRPAS operated two NAVAIR Predator Unmanned Aerial Vehicles (UAVs) at King Salmon, Alaska, from 15 to 19 November to determine the effectiveness of using an UAV in Alaskan airspace. The USCG is particularly interested in the capability of a UAV to support the Maritime Boundary Line (MBL) and High Sea Drift Net (HSDN) missions. These missions require long hours of surveillance over thousands of miles of ocean. The Alaska UAV deployment will provide important information on logistics, communications, and platform capability that will assist in the planning of the more extensive future UAV evaluations.

The two aircraft used in this evaluation are Predator As. This platform has a maximum altitude of approximately 25,000 ft. and a cruising speed of around 70 knots. The Predators have a flight duration of over 48 hours. The aircraft were outfitted with de-icing wings borrowed from the Air Force for use during this deployment. The UAVs and auxiliary equipment were transported to Alaska aboard three USCG C-130s. The C-130s arrived at Edwards AFB on November 6th, were loaded on November 7th, and transported to the test site on November 8th.

The UAV evaluations consisted of five 8-hour flights including one night flight. The UAVs were operated using Line-of-Sight (LOS) communications. Under direction of the FAA, the flights covered a maximum of 100 nautical miles over the coastal region at altitudes up to 18,000 ft. The evaluation consisted of three general types of tests: detection, identification and positional evaluation. Each test day began with surveillance of the operations area. The UAV detects vessels within the area of operations. The UAV then performs an evaluation of position estimation accuracy as a function of range and altitude. The UAV attempts to identify the vessel by name or number and determine on-board activity.

PLASMA IGNITION FOR PULSE DETONATION ENGINES, *continued from page 15*

10,000 times longer than the transient plasma time reported here, and produces a single, small arc, rather than an array of streamers.

The results were quite significant. Ignition delays were reduced by up to a factor of five and the corresponding deflagration-to-detonation time scales were observed to decrease accordingly when compared to conventional ignition systems. The efficiency and performance of the transient plasma ignition strategy will likely contribute to the development of fuel-air detonation initiators.

PROJECT NOTES

REPORT SERIES HIGHLIGHT ACQUISITION RESEARCH PRODUCTS

The Acquisition Research Program of the Graduate School of Business and Public Policy at the Naval Postgraduate School produced a number of research products in coordination with the Acquisition Chair, **RADM Jim Greene, USN (Ret.)** in FY 03. Two of these reports are highlighted below.

Centralized Control of Defense Acquisition Programs: A Comparative Review of the Framework from 1987-2003 (NPS-AM-03-003)
Senior Lecturer John T. Dillard, Graduate School of Business and Public Policy

In the last three years, there has been a great deal of turbulence in U.S. defense acquisition policy. This has led to confusion within the acquisition workforce in terminology, major policy thrusts, and unobvious implications of the changes. The new framework has added complexity, with more phases and delineations of activity, and both the number and level of decision reviews have been increased. Decision reviews are used as top management level control gates, and are also a feature of centralized control within a bureaucracy. Although the current stated policy is to foster an environment supporting flexibility and innovation, Program Managers will now have fewer resources to manage their programs as they spend much of their time, and budgets, managing the bureaucracy. The result could become an endless cycle of decision reviews. Moreover, the implicit aspects of the still new model have not been fully realized, and may result in policy that actually lengthens program and delivers yesterday's technology tomorrow -- counter to goals of rapid transformation. The framework, and its associated requirements for senior level reviews, are opposed to the rapid and evolutionary policy espoused, and are counter to appropriate management strategies for a transformational era.

Reduction of Total Ownership Cost (NPS-AM-03-004)
Senior Lecturers Michael W. Boudreau and Brad R. Naegle, Graduate School of Business and Public Policy

Total Ownership Cost (TOC) is the current initiative to manage costs over the entire life cycle of a weapon system. There are several major categories of costs that contribute to Total Ownership Cost but the principal categories are (1) R&D, (2) Production, (3) Operating and Support, and (4) Disposal. System TOC is the same as Life Cycle Cost (LCC) and has implications for Cost as an Independent Variable (CAIV), cost-performance tradeoffs, affordability, and cost to achieve required operational availability. The Program Manager (PM) is responsible for developing and managing system TOC, with input from key stakeholders, such as the sponsor and users. This paper addresses incentives that can be employed to encourage life cycle cost perspective. It examines the critical issues associated with understanding and implementing the TOC concept and provides recommendations to assist PMs to knowledgeably execute a TOC plan. Metrics necessary to ensure appropriate implementation are explored. Various methods of controlling and reducing TOC are evaluated, including communication among stakeholders, CAIV documentation, tradeoff analysis, Reliability-Centered Maintenance (RCM); Performance-Based Logistics (PBL), Commercial Operations & Support Savings Initiative (COSSI), Earned Value Management System (EVMS), Activity-Based Costing (ABC), Value Engineering, and lessons from R-TOC Pilots.

Additional reports available are listed below. Copies may be printed from www.nps.navy.mil/gsbpp/acqn/publications/index.htm

Sponsored Report Series

NPS-CM-04-001 December 2003
Update of the Navy Contract Writing

NPS-CM-04-002 December 2003
Marine Corps Contingency Contracting MCI

NPS-AM-03-003 September 2003
Centralized Control of Defense Acquisition Programs: A Comparative Review of the Framework from 1987 – 2003

NPS-AM-03-004 September 2003
Reduction of Total Ownership Cost

Working Paper Series

NPS-CM-03-002 June 2003
Transformation in DOD Contract Closeout

Acquisition Case Series

NPS-CM-03-005 September 2003
Contract Closeout (A)

Other Sponsored Research

NPS-CM-03-001 June 2003
Transformation in DOD Contract Closeout (MBA Professional Report)

MOVES INSTITUTE DEMONSTRATES APPLICATION OF OPEN STANDARDS AND WEB-BASED TECHNOLOGIES FOR MILITARY MODELING AND SIMULATION AT I/ITSEC 2003

The NPS Modeling, Virtual Environments and Simulation (MOVES) Institute conducted numerous technical demonstrations and briefings at the 2003 Industry/ Interservice Training, Simulation and Education Conference (I/ITSEC) in Orlando, Florida during the first week of December 2003. With sponsorship of the Defense Modeling and Simulation Office (DMSO) and contributions from the *America's Army* game development project, MOVES students and faculty, together with numerous project partners, configured and manned a booth on the convention show floor. Booth presentations focused on use of open standards and Web services to illustrate capabilities of the new Web-enabled Modeling and Simulation (M&S) initiative called the Extensible Modeling and Simulation Framework (XMSF, http://www.MovesInstitute.org/xmsf).

The XMSF program is led by an academia/industry partnership consisting of the NPS MOVES Institute (**Associate Professor Don Brutzman**), George Mason University (Dr. J. Mark Pullen), Old Dominion University (Dr. Andreas Tolk), and SAIC (Dr. Katherine Morse). DMSO initiated the XMSF program in the summer of 2002. DMSO has declared the Web services approach to be a key technology strategy for revolutionizing military M&S and for connecting M&S capabilities to tactical command and control systems.

XMSF efforts are producing a composable set of standards, profiles and recommended practices for web-based M&S. Open standards, XML-based markup languages, Internet technologies and cross-platform cross-system Web services are enabling a new generation of distributed M&S applications to emerge, develop and interoperate. Working groups in the Simulation Interoperability Standards Organization (SISO, http://www.sisostds.org) and Web3D Consortium (http://www.web3d.org) are laying a strong foundation for future growth.

In addition to XMSF-specific research efforts and *America's Army*, the MOVES XMSF booth also highlighted a number of efforts supporting Joint Advanced Distributed Learning Co-Laboratory (JADL Co-Lab), Joint Forces Command (JFCOM) J9, OPNAV Assessment Division (N81), Naval Undersea Warfare Center (NUWC), U.S. Army TRADOC Analysis Center Monterey (TRAC-Monterey), and Sonalysts, Inc.

The following provides a brief summary of several of the research activities presented at 2003 I/ITSEC with identification of key participants in the MOVES XMSF booth.

Deformable Surfaces: Distributed Real-time Destruction of Building Models Using Ultra-High Resolution Building (UHRB) Format and X3D, presented by MAJ Nick Wittwer, TRADOC Analysis Center, Monterey (TRAC-Monterey), Dr. Niki Goerger, U.S. Army Engineer Research and Development Center (ERDC), Alan Hudson and Justin Couch, Yumetech, Inc., and Michael Pontecorvo, Planet 9 Studios. The MOVES Institute is working with TRAC and ERDC to develop a standard representation of 3D structures for the OneSAF Objective System (OOS). A vocabulary for describing the structures has been designed as an Extensible Markup Language (XML) Schema enabling software to self-validate user, tool, and software generated files describing building structures. XML Stylesheet Language Transformation (XSLT) is used to transform the building descriptions into Extensible 3D Graphics (X3D) representations of the structures for rendering in the Yumetech Xj3D Open Source implementation of the X3D language standard. Physics models are applied to modify the XML representation of the buildings to simulate ordnance effects. The end-to-end process is illustrated in the poster shown in Figure 1. The ERDC Rapid Building Generator tool for conversion of Computer-Aided Design (CAD) files to OneSAF format (upper left in the Process section of the poster) was presented in the booth by Mike Pace from ERDC.

Rapid Building Generation: Conversion of CAD files to OneSAF Format in an End-to-End Process with Deformable Surfaces, presented by Mike Pace, U.S. Army Engineer Research and Development Center (ERDC). Planet 9 Studios also demonstrated several large-scale urban area models they have created.

Online Mentors for Language Training and Cultural Familiarization, presented by **Jeffrey Weekley**, MOVES Institute Research Associate and Computer Science Masters student, Dr. Ed Sims, Chief Technology Officer, Vcom3D, Inc., and Dr. Luba Grant, Defense Language Institute (DLI). The MOVES Institute is working with Vcom3D and DLI to develop an online tutoring system for distance learning. Vcom3D has developed an initial prototype (Figure 2) implementing a short scenario involving a military road block in Iraq. The user interacts with the scenario to make decisions reflecting language usage and cultural cues. Work

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MOVES INSTITUTE DEMONSTRATES TECHNOLOGIES FOR MODELING, *continued from page 18*

is ongoing to further develop the prototype for learning effectiveness studies in the Spring of 2004. Mr. Weekley also described and demonstrated the Scenario Authoring and Visualization for Advanced Graphical Environments (SAVAGE) library of 3D models and authoring tools developed by faculty, students, and contract support over the past 3 years. (http://web.nps.navy.mil/~brutzman/Savage/contents.html).

Web-based Technologies for Analytical Combat Modeling, presented by **Curtis Blais**, NPS MOVES Institute Research Associate and MOVES Ph.D. student. The MOVES Institute is working on two major projects involving application of XMSF concepts to M&S tools supporting military analysis (Figure 3).

The Flexible Asymmetric Simulation Toolbox (FAST), depicted in the lower left of Figure 3, is a collection of models, databases, and

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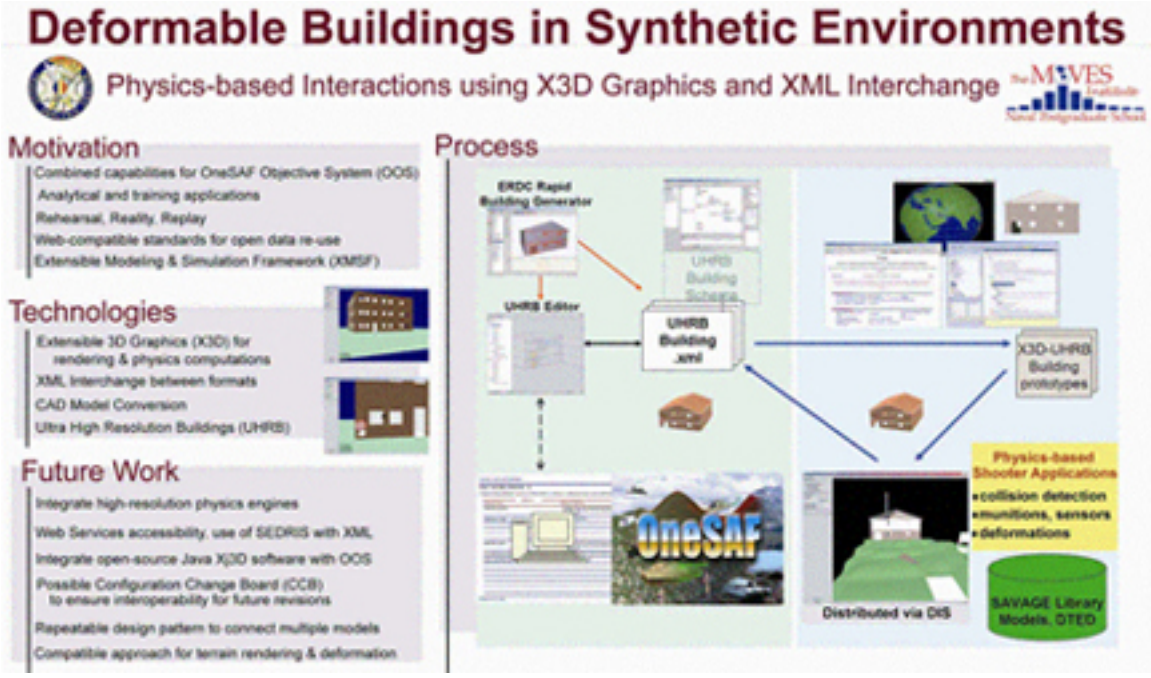

Figure 1. The MOVES Institute is working with TRAC-Monterey and the U.S. Army Engineer Research and Development Center (ERDC) to develop a capability to represent and manipulate 3D representations of structures in support of the OneSAF Objective System (OOS) Simulation using the Extensible Markup Language (XML) family of technologies.

Figure 2. The MOVES Institute is working with Vcom3D and the Defense Language Institute (DLI) to develop an interactive, online instructional aid presenting real-world situations to motivate language training and cultural familiarization.

STUDENT RESEARCH

MARINE CORPS UNIT-LEVEL INTERNAL MANAGEMENT CONTROLS FOR THE GOVERNMENT-WIDE COMMERCIAL PURCHASE CARD

Lieutenant Colonel Robert J. Darling, United States Marine Corps
Lieutenant Colonel Lewis E. Wood, United States Marine Corps
Master of Business Administration – December 2003
Lead Advisor: Senior Lecturer Donald Summers, Graduate School of Business and Public Policy
Support Advisor: Assistant Professor Juliette Webb, Graduate School of Business and Public Policy

In this thesis, recommendations are offered to improve the current internal management controls for the Government-Wide Commercial Purchase Card (GCPC) program. Despite the existence of mandated internal management controls, the program has been fraught with fraud, misuse, and abuse since it's implementation. The 2002 General Accounting Office testimony on the Navy GCPC program noted the continued existence of significant internal control weaknesses, despite a number of improvements made to the program over several years. Using the "fraud triangle" as its philosophical construct, this thesis develops practical methods by which to lessen the ability of those involved with administration of a GCPC program to rationalize improper and illegal actions. Its specific recommendations are to: convert the GCPC cards from individually named credit cards to unit cards with personalized numbers; change the appearance of the cards; control the number of cards within each unit by authorizing level five APCs to define and implement "best practice" controls; and provide electronic receipts of all cardholder transactions daily to Approving Officials and Agency Program Coordinators.

THE SHIPBOARD EMPLOYMENT OF A FREE ELECTRON LASER WEAPON SYSTEM

Lieutenant Gregory G. Allgaier, United States Navy
Master of Science in Applied Physics – December 2003
Advisors: Distinguished Professor William B. Colson, Department of Physics
Second Reader: Associate Professor Robert L. Armstead, Department of Physics

A megawatt (MW) class Free Electron Laser (FEL) shows promise as a new weapon for anti-ship cruise missile defense. An FEL weapon system delivers energy at the speed of light at controllable energy levels, giving the war fighter new engagement options. Considerations for this weapon system include employment, design, and stability. In order to reach a MW class laser, system parameters must be optimized and the high power optical beam must be appropriately managed.

In a high power FEL, the optical beam could heat and ultimately damage the optical cavity mirrors. One proposed solution is a short Rayleigh length design, which lowers the intensity on the mirrors, but increases sensitivity to vibrations. This thesis shows a that short Rayleigh length FEL will remain stable using current technology and can be designed to achieve a MW of power. Scenarios are then presented to explore some of the engagement options associated with this weapon system.

HIGH POWER OPTICAL CAVITY DESIGN AND CONCEPT OF OPERATIONS FOR A SHIPBOARD FREE ELECTRON LASER WEAPON SYSTEM

Lieutenant Timothy S. Fontana, United States Navy
Master of Science in Applied Physics – December 2003
Advisor: Distinguished Professor William B. Colson, Department of Physics
Second Reader: Associate Professor Robert L. Armstead, Department of Physics

A megawatt (MW) class Free Electron Laser (FEL) as a point defense weapon system may lead to a revolution in anti-ship missile defense. Deep magazine, low cost, proportional engagement capability, and speed of light energy delivery provide the FEL with unmatched advantages over kinetic energy weapon systems. Before an FEL is made fleet deployable, stability, system parameter optimization, and operational utility all must be taken into account.

A short Rayleigh length FEL design is being considered in order to reduce system size and mitigate resonator mirror damage. A short Rayleigh length though, can lead to vibrational sensitivities which must be studied. This thesis demonstrates that utilizing currently available technology and properly defined parameters, a short Rayleigh length FEL should be able to achieve a MW of power.

This thesis will also establish the viability of the FEL as a fleet deployable point defense weapon system through the development of a Concept of Operations (CONOPS) which draws from current naval warfare doctrine.

STUDENT RESEARCH

A RELIABILITY PREDICTION STUDY

Lieutenant Commander Russell Dickison, United States Navy
Major Todd Gentry, United States Army
Major Rick Hollen, United States Marine Corps
Major Wendell Leimbach Jr., United States Marine Corps
Lieutenant Nirav Patel, United States Navy
Lieutenant Commander Nathan Schneider, United States Navy
Master of Business Administration – December 2003
Advisor: Senior Lecturer Brad Naegle, Graduate School of Business and Public Policy
Second Reader: Professor Shu Liao, Graduate School of Business and Public Policy

Accurately predicting product reliability allows a manufacturing company to properly evaluate its product, thereby increasing the quality of the product, enhancing sales, and providing accurate cost data regarding warranty costs. The research investigated by the team centered in the areas of reliability growth, reliability modeling and simulation, contractual relationships, quality control, product and process methodology, operational test and evaluation (OT&E), robust design, and lean production. Through these areas, the team conducted research and provided recommendations to better enable the host company in identifying areas that would enhance product quality. The case centered around operational test data and its predictive quality on future warrantee claims.

THERMINATOR: CONFIGURING THE UNDERLYING STATISTICAL MECHANICS MODEL

Lieutenant Daniel W. Ettlich, United States Navy
Master of Science in Electrical Engineering and Master of Science in Computer Science – December 2003
Advisors: Associate Professor John C. McEachen, Department of Electrical and Computer Engineering and LCDR Chris S. Eagle, USN, Department of Computer Science

The rapid increase in sophisticated Internet attacks has left the security industry lagging far behind. In an attempt to improve network security, Therminator, a patternless intrusion detection system, was developed in 2001 by NPS in conjunction with NSA. The Therminator model uses statistical mechanics to analyze network traffic as a system of exchanges. Being highly configurable enables Therminator to be adapted for any network configuration. Until now, however, no exploration had been conducted on the configuration parameters of the underlying statistical mechanics model. It is important to understand the effects of these parameters to optimize anomaly detection. Thus the current study explored these parameters using HTTP traffic generated in a controlled test environment. Results were as follows: equations were developed for state counting to determine bucket state space sizes; bucket state space

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INFORMATION TECHNOLOGY PORTFOLIO MANAGEMENT AND THE REAL OPTIONS METHOD (ROM): MANAGING THE RISKS OF IT INVESTMENTS IN THE DEPARTMENT OF THE NAVY (DON)

Lieutenant Commander Jeffery P. Davis, United States Navy
Master of Business Administration – December 2003
Advisors: CDR Philip Candreva, USN, and Associate Professor Kenneth Doerr, Graduate School of Business and Public Policy

The FY 2003 Federal Budget contains provisions for over $52 billion in IT investments. The Navy portion of those funds is over $5 billion. Rapid change and increasing uncertainty in the technology field has resulted in a high degree of financial risk associated with IT capital investment decisions. The Federal Chief Information Officer (CIO) Council has endorsed IT Portfolio Management (ITPM) as an approach for making IT investment decisions. This research draws upon ITPM implementation strategies currently employed by the DON and provides recommendations for managing the inherent risk in IT investments, specifically the application of the Real Options Method (ROM). ITPM provides a thoughtful framework for managing the capital investment process but still depends primarily on traditional methods such as EVA, IRR and NPV for evaluating IT investment alternatives. This study uses the Naval Supply Systems Command (NAVSUP) Automatic Identification Technology (AIT) program to illustrate how ROM can be utilized to supplement these traditional valuation methods and aid in managing investment risks. IT capital investments are inherently linked to organization strategy and the uncertainties that define the future. This study demonstrates how ROM can allow managers to capitalize on the uncertainties of IT investment decisions to implement organization strategy.

STUDENT RESEARCH

IMPROVEMENT OF THE PERFORMANCE OF A TURBO-RAMJET ENGINE FOR UAV AND MISSILE APPLICATIONS

Captain Dimitrios Krikellas, Hellenic Air Force
Master of Science in Applied Physics and Master of Science in Aeronautical Engineering – December 2003
Advisor: Professor Garth V. Hobson, Department of Mechanical and Astronautical Engineering
Second Reader: Emeritus Professor Kai E. Woehler, Department of Physics

An existing turbo-ramjet engine was modified in order to increase the produced thrust and sustain combustion at increased freejet Mach numbers. The engine's afterburner fuel system was redesigned to improve the vaporization and atomization of the fuel. The engine performed satisfactorily at speeds up to Mach 0.3, producing 100% more thrust over the baseline turbojet. The data acquisition system of the turbo-ramjet engine's performance measurement in a freejet facility was also updated. Various Computational Fluid Dynamics models of the flow through the turbo-ramjet engine were developed to visualize the flow and to predict the engine performance at different Mach numbers.

FLEXIBLE MULTIBODY DYNAMICS AND CONTROL OF THE BIFOCAL RELAY MIRROR

Captain Brian M. Moore, United States Army
Astronautical Engineer and Master of Science in Astronautical Engineering – December 2003
Advisor: Distinguished Professor Brij N. Agrawal, Department of Mechanical and Astronautical Engineering
Second Reader: Dr. Marcello Romano, National Research Council Research Associate

In recent years, spacecraft have become increasingly flexible. The design requirements for the Bifocal Relay Mirror spacecraft include controlling jitter at the nanoradian level. Typically, tight pointing requirements require high structural stiffness, at the cost of increasing the on-orbit mass. To accomplish this, while minimizing the mass of the spacecraft, the structure will have some inherent flexibility. These flexible modes will interact with the pointing control, hence affecting the payload performance. The compensator design conducted in this thesis achieves order of magnitude improvements in controlling the rate error, hence jitter. This thesis starts with a rigid body dynamic model, and develops a flexible body dynamic model. Once the model is developed, the structure-controls interaction is discussed. Finally, compensators are applied to the rigid body controller to mitigate the performance losses present in the flexible body system. Through classical second-order compensators, the angular rate error was decreased by a factor of ten. Nonminimum phase notch filters and phase lag filters were used. Ultimately, the phase lag filters provided the best performance.

THERMINATOR: CONFIGURING THE UNDERLYING STATISTICAL MECHANICS MODEL, *continued from page 21*

size was found to be symmetrical about the midpoint of the boundary conditions; proper display period was based on traffic rate; and lastly, the more orthogonal anomalous traffic was to the normal traffic, the larger the perturbation was in the state graph. These results provide needed insight into properly configuring Therminator for optimal anomaly detection, ultimately affording the Department of Defense greater network security.

LAND REFORM AND CONFLICT RESOLUTION IN COLOMBIA

Lieutenant Mark S. Nieswiadomyt, United States Navy
Master of Arts in National Security Affairs – December 2003
Advisor: Assistant Professor Harold Trinkunas, Department of National Security Affairs

One of the leading arguments explaining the current rural conflict in Colombia is that it stems from deeply rooted peasant grievances over lack of land. As is true in much of Latin America, Colombia has one of the highest levels of inequality of land ownership in the world. Yet in over four decades worth of land titling effort, INCORA, Colombia's national land reform agency, has been unable to change the overall high concentration of land ownership. This thesis examines to what effect, if any, a redistributive land reform policy implemented amid the ongoing rural conflict would have on its resolution.

While social scientists have developed a multitude of theoretical explanations of "why peasants rebel," little attention has been given to how land reform implemented during intra-

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STUDENT RESEARCH

REENGINEERING HUMAN PERFORMANCE AND FATIGUE RESEARCH THROUGH USE OF PHYSIOLOGICAL MONITORING DEVICES, WEB-BASED AND MOBILE DEVICE DATA COLLECTION METHODS, AND INTEGRATED DATA STORAGE TECHNIQUES

Major Maureen J. O'Connor, United States Army
Lieutenant Paul L. Patillo, United States Navy
Master of Science in Information Technology Management – December 2003
Advisor: Professor Nita L. Miller, Department of Operations Research
Co-Advisor: Professor Thomas J. Housel, Department of Information Science

In the field of human research, particularly in operational environments, data collection techniques are difficult. Researchers often focus their efforts on the data analysis and overlook the shortcomings of their data collection and storage methodologies. In order to demonstrate effective data collection and storage methodology in a representative human research process, the process used by human fatigue and performance researchers at the Human Systems Integration Lab at the Naval Postgraduate School (NPS) served as a Proof of Concept for this thesis. Most recent studies conducted at NPS provided a model of the current process. The Knowledge Value Added (KVA) methodology was used as a tool of comparison of the current process to the reengineered process. Information technologies including wireless physiological monitoring devices, web-based and mobile device data collection methods, and integrated data storage techniques were incorporated in the reengineering effort. The data storage process included the design of a standard relational database format allowing research teams to easily access their data. This repository also enables data to be archived for future use (e.g., meta-analyses). To demonstrate the reengineered process in an operational environment, a field fatigue study was conducted at the Naval Officer Indoctrination School (OIS) in Newport, Rhode Island.

LAND REFORM AND CONFLICT RESOLUTION IN COLOMBIA, *continued from page 22*

state conflict is to resolve peasant insurgencies. Devoid of a theoretical framework, policymakers have looked towards two well-known cases of land reform in South Vietnam and El Salvador to base much of their decision making on the merits of land reform in the Colombian case. Yet this thesis finds that these two cases do not provide sufficient evidence to suggest a similar failure of land reform in the Colombian case. Furthermore, this thesis confirms that there is a strong historical nexus between land and conflict in Colombia, and since the mid-1990s, the intensification of the rural conflict resulted from: (1) the phenomena of "reverse land reform" where narco-traffickers purchased vast sums of land attempting to launder illicit drug profits; (2) an increase in rural income inequality; and (3) a significant shift from illicit coca cultivation in Bolivia and Peru to Colombia.

Ultimately, this thesis finds that as a "stand alone" policy, redistributive land reform will not only be a difficult agenda item for Colombia's president to find political support for, but its very implementation will be violently contested by guerrillas, paramilitaries, and narco-traffickers. This thesis concludes by offering potential alternative approaches or "paths" that make redistributive land reform feasible in Colombia, with special emphasis on a rural pacification, asset forfeiture, and post-conflict requirements.

RESIDENTIAL COMMUNITIES INITIATIVE: A CASE STUDY

Captain Michael R. Zahuranic, United States Army
Gary R. Boyd, DoD Civilian
Master of Business Administration – December 2003
Advisor: Senior Lecturer Jeffrey R. Cuskey, Graduate School of Business and Public Policy
Second Reader: Lecturer Cary Simon, Graduate School of Business and Public Policy

The purpose of this MBA report was to investigate and provide a comprehensive overview of the Residential Communities Initiative within the United States Army. This project was conducted with the assistance of the Monterey Bay Housing Program Executive Office and the Program Manager for the Residential Communities Initiative. The goal was to analyze this initiative and compare the way the Army is privatizing housing with the initiatives that the United States Navy and United States Air Force are utilizing. We also wanted to use Monterey Bay as a case study to investigate how Residential Communities Initiative was instituted at an installation and analyze this from a business and contracting standpoint.

INTERAGENCY CENTER

NATIONAL TRANSPORTATION SECURITY CENTER FORMED THROUGH PARTNERSHIP BETWEEN THE NAVAL POSTGRADUATE SCHOOL, UNIVERSITY OF CALIFORNIA (LAWRENCE LIVERMORE NATIONAL LABORATORY) AND SAN JOSE STATE UNIVERSITY (MINETA TRANSPORTATION INSTITUTE)

A Memorandum of Understanding between the University of California (UC), which operates and manages the U.S. Department of Energy's Lawrence Livermore National Laboratory (UC/LLNL), the Mineta Transportation Institute (MTI) at San Jose State University (SJSU), and the Naval Postgraduate School (NPS) was recently signed to provide the cooperative framework for the UC/LLNL, MTI, and the NPS to jointly establish the National Transportation Security Center (NTSC). The objective of this joint effort is to conduct technical and systems research, to implement outreach programs, and to conduct academic and training programs, which allow the United States transportation community to be optimally prepared to protect against and recover from future terrorist activities.

Security experts recognize that, with the preeminence of the U.S. military power, future conflicts will be covert, using terrorist tactics rather than direct military confrontations. Consequently, the nation has experienced an increasing terrorist threat, with the 9/11 atrocities appropriately focusing both governmental and public concern on this topic.

Yet three farsighted organizations began to conduct research, education, and training programs on this subject years before the 9/11/01 event. Those three organizations are now preeminent in their specialty fields and are choosing to combine those proven skills into a coordinated effort that stresses areas of excellence while avoiding redundancies that waste effort and funding. Those three programs and the concomitant complementary skills are as follows:

Lawrence Livermore National Laboratory will have lead responsibility for the technical research component of the NTSC. For 50 years, the University of California has operated and managed LLNL for the U.S. Department of Energy. During that time, UC/LLNL has focused the best scientific and technical talents of the nation on ensuring the security of the United States. UC/LLNL provides science and technology that underpins the U.S. nuclear deterrent as well as critical technical capabilities for nonproliferation and counter-terrorism. This expertise and skill base is also being applied to today's homeland security challenges.

The Nonproliferation, Arms Control, and International Security Directorate (NAI) of the UC/LLNL has been in operation since 1992 and has conducted the most sensitive and effective technical research relating to counter-terrorism

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STUDENT RESEARCH

SPACE AND NAVAL WARFARE SYSTEMS CENTER-SAN DIEGO STUDENT RESEARCH FELLOWSHIPS AWARDED

The Space and Naval Warfare Systems Center-San Diego (SSC-SD) announced the awards of the latest round of SSC-SD Fellowships. SSC-SD sponsors a Student Research Fellowship Program at NPS. The program was instituted to promote NPS's partnership with SSC-SD, address SSC-SD's research focus areas, lay the groundwork for future technical and project management assignments, and foster long-term professional associations with SSC-SD's technical personnel and management. There are two rounds of awards each year. NPS students submit proposals that are reviewed by the technical staff of SSC-SD and approved by the SSC-SD Commander. Seventy-nine students have been awarded fellowships to date. The fellowship includes a $10,000 award to support the student's research. The latest recipients (along with the title of their successful proposal) are:

LT Joseph D. Sears, United States Navy
Project: A Protocol for Simultaneous Session Management and Protection in a Multilevel Environment
NPS Advisor: **Associate Professor Cynthia Irvine**, Department of Computer Science
SSC-SD Mentor: CDR Daniel L. Currie, PMW-161, Information Operations

Ensign Trevor J. Baumgartner and **Ensign Matthew D. Phillips**, United States Navy
Project: Specification, Design an Implementation of a High Assurance Network Address Translation Over Ipv6
NPS Advisor: **Associate Professor Cynthia Irvine**, Department of Computer Science
SSCSD Mentor: CDR Daniel L. Currie, PMW-161, Information Operations

NATIONAL TRANSPORTATION SECURITY CENTER, *continued from page 24*

and national security. Many of the most sophisticated sensing devices for weapons of mass destruction have been and are being developed and evaluated by NAI. NAI facilities draw on the finest minds in the field and are hosted in a secure environment allowing the most sensitive materials and information to evolve.

NAI/Homeland Security Organization is tackling key homeland security challenges in the following areas:

- Countering the Nuclear Threat (Cargo Security and Detection and Tracking Systems)
- Defending Bio-terrorism (Advanced Bio-detection Technology and Biological Signatures)
- Chemical Analysis for Forensic Science (Forensic Science Center and Chemical Sensors)
- Search and Security Technologies (Concrete Penetrating Radar, Baggage Screening Technologies, and Truck Stopping Devices)
- Protecting Against Cyber Attack

The **Mineta Transportation Institute (MTI)** will have lead responsibility for the policy research and information dissemination and outreach component of NTSC. Congress created MTI in 1991 and reauthorized the Institute in 1998. MTI competed successfully in 2002 to be designated as a "National Center of Excellence" by the U.S. Department of Transportation's (DOT) Research and Special Programs Administration. MTI is guided by a world-class Board of Trustees and provides three interdependent services: 1) surface

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The Center for Homeland Security was formed in 2001 under the direction of **Associate Professor Paul Stockton**, Department of National Security Affairs, and **Professor Ted Lewis**, Department of Computer Science. The Center is the focal point for coordination of the NPS homeland security initiative and in doing so initially obtained support from the Department of Justice (DoJ).

The curriculum and research priorities detailed in an initial interagency agreement with DoJ, and continued with the Department of Homeland Security, focus on opportunities to strengthen the U.S. capacity to deter, defeat and respond to threats to homeland security. Efforts deal with civil-military and interagency challenges of HLS planning and operations. The curriculum includes both technical and non-technical components, i.e., protection of critical infrastructure, history, policy, etc. Modeling and simulation are built into the heart of the curriculum.

The NPS homeland security program is structured for maximum effectiveness and efficiency. The key components are:

- Mobile Education Team Seminars: The goal of this program is to bring executive level education on HLS to Governors' staff. A typical seminar will last two days and be delivered to major regions of the United States. NPS expects to execute 8-10 seminars per year.
- Executive Education for State Executives: These one-to-two week courses are aimed at senior executives and policymakers. The goal is to provide brief, but intensive, education programs for existing senior leadership in HLS. An additional goad is to build teamwork by enrolling a broad range of participants and regional perspectives (multiple State and Federal agencies). This allows for comparative analysis of different approaches to HLS, strengthens cooperation across disparate Federal agencies, and enhances local/State/Federal understanding and cooperation.
- Masters Degree Curriculum: A Master of Arts in Security Studies with a specialization in HLS has been developed. It is the first Masters program in the U.S. with a focus on HLS. NPS has developed a hybrid approach for delivery for the 18-month program intended for experienced, high-level public safety administrators. Students will complete two courses per quarter via distributed learning. These courses will consist of online scenario based exercises and research work support by the HLS e-library at NPS. Students will also spend two weeks in residence at NPS each quarter, one each at the beginning and end of each quarter. The resident modules will serve to launch the two-courses at the beginning of the quarter and allow students to complete and present their research findings at the conclusion of the quarter. Additionally, the NPS Masters program thesis requirement allows for a two-way payback to students sponsors by providing high-quality, low-cost research on topics of concern to sponsors and creating subject matter experts who can help lead future policy development and operational planning efforts.
- Digital Library: The HLS e-library at NPS will support students during their program as well as after graduation. It will be an on-line resource for the Department of Homeland Security, and other local, State and Federal agencies.

NATIONAL TRANSPORTATION SECURITY CENTER, *continued from page 25*

transportation policy research conducted by the 120 PhD level certified MTI Research Associates, 2) an accredited California State University Master of Science in Transportation Management (MSTM) degree and a professional Certificate in Transportation Management (CTM); classes are delivered via the California Department of Transportation videoconference bridge to as many as 24 sites in the state, and to the mobility impaired and those outside of California via interactive webstreaming, and 3) the MTI website which averages over 100,000 uses per month and over 1,000 downloads of printed material per week.

The most prominent of the five MTI policy research subject areas began in 1995 under the direction of MTI Research Associate Brian Michael Jenkins and consists of the counter-terrorism research and information dissemination effort that will be the focus of NTSC. MTI has conducted two national security symposia, the most prominent of which was the "National Transportation Security Summit" requested by the American Association of State Highway and Transportation Officials (AASHTO) and the American Public Transportation Association (APTA) and co-sponsored by U.S. and California DOTs on October 30, 2001 in Washington, D. C. In addition, at the request of California DOT, MTI conducted two "California Transportation Security Summits" in early 2002. Those sessions and others focused on the dissemination of U.S. DOT security training program information as well as MTI research results including: 1) formal case studies of the 14 major terrorist attacks in the world against surface transportation targets since 1990, including a recently released case study on the response on 9/11/01 by the transit systems in New York, 2) vulnerability assessments of 11 transit agencies and bridges, 3) a chronology of reported surface transportation terrorist attacks since 1920, and 4) a summary vulnerability check list for use by local transportation jurisdictions. That information is desensitized and available in PDF and HTML formats on the MTI website at http://transweb.sjsu.edu.

The **Naval Postgraduate School (NPS)** working through its Center for Homeland Security and Defense will have lead responsibility for graduate education for homeland security for the NTSC. The Naval Postgraduate School has long supported the interests of the Department of Defense (DoD) and Department of Navy (DoN) by aligning upper division course content and faculty and student research. Since the events of 11 September 2001, NPS has begun a new initiative to strengthen NPS' ability to help meet a critical national security challenge. In response to the Secretary of Defense's designation of Homeland Security (HLS) as a top priority DoD mission, NPS is leveraging its unique capabilities to accomplish specialized graduate education and research requirements. NPS has an accredited Master of Arts degree in the field of Security Studies, with a specialized track in Homeland Defense and Security (HD/S). The HD/S curriculum enrolls senior local, State and Federal leaders (both civilian and military) who are current and future leaders in the homeland security realm. Transportation security issues are important across a variety of courses already taught in the curriculum, and could provide the basis for additional course development initiatives (as well as for faculty and student research). Building on existing NPS academic expertise in the areas of critical infrastructure protection (including information systems and networks), counter terrorism, civil military relations, operations research, command, control and communications, modeling and simulation, intelligence, and much more, NPS will utilize its diverse enrollment to strengthen civil military and interagency teamwork. Accordingly, with the active participation of its partners, NPS will take the lead in developing and delivering graduate education components of the overall cooperative work of the National Transportation Security Center.

The individuals responsible for coordinating and pursuing the objectives of this Memorandum of Understanding are Harry Vantin, Associate Director for NAI, Rod Diridon, Executive Director of MTI, and **Associate Professor Paul Stockton,** Director of the NPS Center for Homeland Security and Defense. These individuals will serve as the "NTSC Coordinating Council" and shall recommend related research and programs to the respective cooperating organizations. Specific joint efforts of the NTSC may include, but are not limited to:

- The conduct of both practical and theoretical research on materials and equipment for use by transportation organizations and security personnel to protect against and recover from terrorist activities (UC/LLNL lead).
- Conduct new technical research on transportation security materials and equipment as requested by public and private agencies (UC/LLNL lead).
- The development of technical systems analysis to support transportation security studies. (UC/LLNL lead).
- Explore the technical implications of policy decisions (UC/LLNL lead).

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PARTNERSHIPS

MEMORANDUM OF UNDERSTANDING CONTINUES CHAIR OF APPLIED SYSTEMS ANALYSIS AT THE NAVAL POSTGRADUATE SCHOOL

A Memorandum of Understanding between the Chief of Naval Operations Assessment Division/Capability Analysis Group (N81/N00X) and the Naval Postgraduate School (NPS) continues support for the Chair of Applied Systems Analysis at Naval Postgraduate School. The Chair of Applied Systems Analysis was established to act as a liaison point for collaborative efforts between Chief of Naval Operations Assessment Division/Capability Analysis Group, (N81/N00X), and the NPS Department of Operations Research, NPS (OR). This cooperative effort provides valuable opportunities for faculty and student professional development at NPS while enhancing N81/N00X's ability to conduct studies, assessments, analyses, and evaluations of plans, programs and strategies in support of the Chief of Naval Operations. The Chair of Applied Systems Analysis will undertake a number of activities to include:

- Identifying and coordinating opportunities for NPS students and faculty to support N81/N00X in carrying out studies, analyses, and assessments;
- Assisting in securing thesis/research tours for students at appropriate analytical organizations;
- Liaison with other services, Joint Chiefs of Staff (JCS), Office of the Secretary of Defense (OSD), and Combatant Commands (COCOM);
- Teaching and carrying out research in support of the Operation Analysis (OA) and related curricula;
- Participating in the activities of appropriate professional societies and organizations such as MORS and INFORMS;
- Traveling to N81/N00X and other organizations as necessary to carry out the of duties the Chair;
- Conducting joint marketing initiatives with N81/N00X and staff to attract Naval officers into the OA subspecialty.

The current Applied Systems Analysis Chair Professor is **CAPT Starr King, USN,** of the Department of Operations Research.

MEMORANDUM OF AGREEMENT WITH DIRECTOR OF INTELLIGENCE, USSOUTHCOM J2, PROMOTES RESEARCH INITIATIVES

A Memorandum of Agreement between the Naval Postgraduate School and the Director of Intelligence, U.S. Southern Command (USSOUTHCOM J2) establishes a collaborative relationship of analytical support and exchange between the students and faculty of NPS' National Security Affairs Department and USSOUTHCOM J2 Joint Intelli-

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NATIONAL TRANSPORTATION SECURITY CENTER, *continued from page 26*

- The development of training materials for the application of materials and equipment for use by transportation organizations and security personnel to protect against and recover from terrorist activities (UC/LLNL lead).
- Conduct policy research on transportation security topics as requested by public and private agencies (MTI lead).
- The conduct of detailed, standardized, best practices case studies of every major terrorist event involving transportation facilities in the world (MTI lead).
- The standardization, updating, and trend-line evaluations of a continuing chronology of every terrorist event involving transportation facilities (MTI lead).
- Develop and periodically update a "self assessment" checklist for vulnerability assessment of various types of transportation facilities (MTI and NPS co-leads).
- Using the material developed by the research provided by UC/LLNL, MTI and other sources, develop and continually upgrade the curriculum for a Master of Arts/Science in Security Administration or related degrees and professional certifications for both public and private students (NPS lead).
- Using the materials developed by UC/LLNL, MTI and others, develop a security personnel training program, which may lead to professional certification for various types of transportation facilities for implementation both at a central site and in the work place (NPS lead).
- Referral of students who are pursuing related programs among the three organizations (All).
- Seeking other opportunities for mutual support for SJSU/MTI and NPS for existing graduate degree and certification programs (All).
- Other programs and projects as encountered and pursued cooperatively by NTSC (All).

MEMORANDUM OF AGREEMENT OUTLINES LAUNCH FOR THE NAVAL POSTGRADUATE SCHOOL'S SPACECRAFT ARCHITECTURE AND TECHNOLOGY DEMONSTRATION SATELLITE

An agreement between the Naval Postgraduate School and the United States Air Force Space and Missile System Center Detachment 12 DoD Space Test Program (STP) outlines the scope of effort for the integration and launch of NPS' spacecraft architecture and technology demonstration satellite, NPSAT1. STP will provide launch services and support to place NPSAT1 into the required orbit as defined in the Space Flight Plan. NPSAT1 is being built by NPS faculty and students and is scheduled for launch in 2006. NPS previously launched a student-built satellite in 1998. PANSAT (Petite Amateur Navy Satellite) involved over 50 NPS students in its design and launch.

MEMORANDUM OF AGREEMENT WITH DIRECTOR OF INTELLIGENCE, USSOUTHCOM J2, *continued from page 27*

gence Center (JIC). This support is consistent with NPS strategic initiatives to improve the quality and applicability of its research and teaching.

NPS' National Security Affairs (NSA) Department represents a unique resource of students and faculty to help support numerous long-term, strategic research projects at USSOUTHCOM JIC. NSA and JIC will designate liaisons to coordinate student and faculty research projects.

SUPPORT AGREEMENT WITH MILITARY SEALIFT COMMAND CONTINUES SUPPORT FOR ADMIRAL STANLEY ARTHUR CHAIR OF LOGISTICS AT NPS

A Support Agreement was recently initiated between the Military Sealift Command (MSC) and the Naval Postgraduate School (NPS) to provide a direct relationships between MSC and NPS to: 1) manage relevant research supportive of MSC requirements, and 2) provide opportunities for professional development of both faculty and students in the concept, principles, and

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NPS DEFINES EDUCATION AND RESEARCH NETWORK

For the past year, the Naval Postgraduate School has been working to define and engineer the Education and Research Network (ERN). The ERN was recommended in NPS' IT (Information Technology) Strategic Plan, *The Information Revolution: Planning for Institutional Change* in order to provide additional IT capabilities for the university. The first visible element of ERN implementation will begin in February 2004, when faculty, students and academic staff will transition to an .edu domain name. For the first time, most NPS computer users will choose an .edu domain instead of .mil for their campus e-mail addresses. Usernames will not change. The new nps.edu domain name reflects the academic nature of our mission, and brings instant recognition of NPS as a university environment.

Other benefits of ERN implementation include additional bandwidth and improved reliability in our network connections to the global Internet, closer working relationships with other institutions of higher learning, redundant network design, and access to Internet2, the "next generation" research network. The nps.edu domain will connect via California State University Monterey Bay (CSUMB) to a CalREN-2 channel supporting 155 Mbits/sec sustained bit rate, with up to 622 Mbits/sec bursts. These speeds are approximately seven times faster than the current capabilities of our DREN .mil network. The upgraded capabilities of the ERN will support improved research, collaboration and multimedia capabilities for the NPS campus community.

The existing .mil network capabilities will remain in place to serve the DoD research opportunities and administrative needs of the campus. All security and administrative mandates regarding upgrades, anti-virus protection, policies and procedures will apply to both .mil and .edu networks. Both networks will continue to be well-managed and secure, but the performance of ERN will be faster and more reliable.

Information Technology and Communications Services (ITACS), the IT organization at NPS, is pleased to recognize the educational and research benefits resulting from the collaborative efforts of California State University Monterey Bay, the Naval Postgraduate School, and the City of Monterey, which brought ERN into being. The combination of computing and communications "is at the forefront of the intellectual revolution" per Richard Atkinson, former President of the University of California, and this combination of university and community collaboration will permit the Naval Postgraduate School to realize its next level of accomplishment as a research university.

CHAIR PROFESSORSHIPS

NATIONAL SECURITY AGENCY (NSA) CRYPTOLOGIC RESEARCH CHAIR REPORTS ONBOARD TO THE NAVAL POSTGRADUATE SCHOOL

Mr. James Ehlert, the new NSA Cryptologic Research Chair, reported onboard to the Naval Postgraduate School (NPS) in November 2003. Mr. Ehlert arrived from his previous assignment at the National Security Agency/Central Security Service (NSA/CSS) Pacific (NCPAC), located at Camp Smith, Hawaii. Stationed at NCPAC from 1998-2003, Mr. Ehlert served as an integree to the U.S. Pacific Command J39 Information Operations Division where he was responsible for planning and executing Computer Network Attack and Defend capabilities in support of Combatant Commander requirements.

Mr. James Ehlert

While serving as the NSA Cryptologic Research Chair, Mr. Ehlert intends to assist NPS in the development and refinement of cryptologic courses, to promote advanced level research accomplishments, to explore areas of mutually beneficial joint research benefiting both the NPS and NSA, to support technology transfer, and to contribute to the academic resources of the NPS in order to enhance the graduate education of military officers.

Mr. Ehlert is a former U.S. Naval Officer and graduate of the U.S. Naval Academy (Class of 1989) where he earned his B.S. in Ocean Engineering. He is also an NPS graduate (1995) where he earned his M.S. in Computer Science. In addition, Mr. Ehlert is also a Professional Engineer (State of Maryland) and has been professionalized by NSA in Software Applications.

The NSA Cryptologic Chair Professor was established by a memorandum of agreement between the Naval Postgraduate School (NPS) and the National Security Agency (NSA) and allows for the assignment of a NSA employee to the faculty of the NPS as Cryptologic Chair. The purpose of this program is to provide for the assignment of eminent civilian professionals to enrich the faculty of the NPS and to enhance the graduate level education of the military officers and the NSA civilians enrolled.

SUPPORT AGREEMENT WITH MILITARY SEALIFT COMMAND, *continued from page 28*

application of Sea Basing within DoD, with particular emphasis on Inventory and Defense Transportation Management. The specific research objective is to ensure research in topics of interest to the MSC is carried out and to stimulate and coordinate continuing relevant research conducted by NPS faculty and students. The specific educational objective is to enhance the capabilities of graduates to assume management and policy-making positions within the Department of the Navy.

The Admiral Stanley J. Arthur Chair of Logistics provides focused and relevant expertise in the full spectrum of supply chain management in DoD. This agreement affirms the criteria for the chair professorship in the Graduate School of Business and Public Policy under the sponsorship of the Military Sealift Command. The current chair incumbent is **RADM Donald Eaton, USN (Ret.)**.

NORTHROP GRUMMAN SHIP SYSTEMS CHAIR PROFESSORSHIP ESTABLISHED

The establishment of a Northrop Grumman Ship Systems Chair at the Naval Postgraduate School has enhanced the Systems Engineering Curriculum by introducing an industrial perspective not usually found in an academic environment. Visiting Professor **Bill Solitario** brings over forty years of industrial engineering experience to NPS. His early professional career included work on the Apollo Program and other aerospace programs at North American Aviation and TRW. The Systems Engineering skills developed at TRW were ultimately applied to the Proposal and Design Phases of both the LHA Tarawa Class as well as the DD963 Spruance Class Ship contracts. These were the first major combatants designed by industry using Systems Engineering, based on operational requirements developed by the Navy. Both of these ship classes were technically successful,

William Solitario

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TECHNOLOGY TRANSFER

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS FACILITATE COLLABORATIVE EFFORTS WITH INDUSTRY

The Naval Postgraduate School has an active Technology Transfer Program. Technology is transferred to the private sector primarily through the publications of the faculty and students. NPS also interacts with industry, universities, and non-profit agencies on collaborative research efforts through Cooperative Research and Development Agreement (CRADAs). Recent agreements are highlighted here.

UNITED DEFENSE LP ARMAMENT SYSTEMS DIVISION

NPS Program Manager: Research Associate Curtis Blais, Modeling, Virtual Environments and Simulation Institute

NPS has developed substantial experience as a developer and user of the Naval Simulation System (NSS) in conjunction with Naval Gun Fire Support and Expeditionary operations. United Defense has extensive background in the development of advanced engagement subsystems – the gun and missile launcher subsystems in particular – for the Littoral Combat Ship (LCS). As such United Defense has embarked on an IR&D project for evaluation of these systems and subsystems using Advanced Combat Modeling tools for evaluation. This agreement will allow the partners to enhance the capabilities of NSS for both government and commercial applications.

All efforts under this CRADA are directed towards the development of advanced guns and gun weapon systems and will be accomplished under specific written projects tasks that are discussed and agreed upon by the Collaborators.

United Defense plans on using the advanced M&S tools, techniques, and other research support provided by the NPS under this CRADA to support IR&D projects including, but not limited to the Navy's LCS program. United Defense's IR&D projects are designed to improve the Navy's overall M&S research and development tools, capabilities and expertise, and to develop advanced, high-fidelity gun weapon system and launcher models that will be used to analyze and evaluate advanced engagement subsystem design concepts that United Defense is developing.

United Defense expects to use the NSS combat system analysis and design support, for key product areas that fall within the areas of engagement subsystems, gun weapon systems and missile launchers. These systems can be created as separate systems in NSS and therefore allow establishing the effectiveness of system and subsystem design on the outcome of a campaign level scenario. NPS has the expertise and research facilities to collaborate with United Defense in the design and development of system and subsystem level objects, combat fires scenarios, and specific Measures of Effectiveness that will enhance the research and analysis conducted by United Defense.

Establishing a CRADA with NPS provides United Defense with access to a wide range of powerful Modeling and Simulation (M&S) research and development tools and techniques that

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NORTHROP GRUMMAN SHIP SYSTEMS CHAIR, *continued from page 29*

introducing innovations such as gas turbine propulsion, and each Class has derivatives including the current LHD and the CG47 Ticonderoga Class.

During the span of 30+ years at Litton Ship Systems/ Northrop Grumman Ship Systems (NGSS), Solitario held management positions including Director of Design Engineering and Director of Research and Development. He is bringing this directly applicable experience to bear as the overall coordinator of the System Engineering and Analysis (SEA) 5 Maritime Dominance, System of Systems Project, as an advisor to the other SEA and Total Ship Systems Engineering (TSSE) student projects and the SI4000 Systems Engineering Seminar Class which he directs.

NGSS and NPS also signed a Cooperative Research and Development Agreement (CRADA) which enables an exchange of data and participation in Research and Development programs of mutual interest. A number of specific projects are under consideration including one which will address the launch and recovery of Unmanned Vehicles from Surface Combatants. The CRADA also sponsored a visit by the (TSSE) Class to the NGSS New Orleans Avondale Shipyard. The students were given presentations on current R&D projects as well as the State of the Art 3D Ship Modeling and Design System used to design and build the LPD 13 Class Amphibious Assault Ship. They in turn gave a presentation on their TSSE ship design project and the discussion that followed enabled the students and shipbuilders to exchange ideas on current LCS designs.

NORTHROP-GRUMMAN SHIP SYSTEMS, INC.

NPS Program Manager: Distinguished Professor Phil Depoy, Wayne E. Meyer Institute of Systems Engineering

This collaborative effort allows NPS and NGSS (Northrop Grumman Ship Systems) employees and students to share their respective expertise (academic programs from NPS, defense industry from NGSS). NGSS will provide a NGSS Systems Engineer to serve as the Chair of Systems Engineering at NPS. NGSS will also provide four NGSS Engineers to participate as students in the Product Development 21 and/or Systems Engineering and Analysis Programs. Both programs address defense-related product development and acquisition.

The Chair of Systems Engineering will interact and participate in research projects related to Systems Engineering in the Wayne E. Meyer Institute of Systems Engineering and across the NPS campus as may be appropriate. The NGSS Engineering Students will interact with military and DoD civilians in their respective academic programs to provide defense industry perspective on defense product development issues and research initiatives at NPS.

UNITED DEFENSE LP ARMAMENT SYSTEMS DIVISION, *continued from page 30*

will improve United Defense's understanding of combat systems M&S and design. NPS will obtain access to the latest research and development in advanced shipboard gun weapon systems, and launcher systems. NPS will also receive and use non-proprietary data to enhance its Advanced Combat Modeling M&S tools and techniques which will be used to develop further enhancements and improvements to its Advanced Combat Modeling tools, such as the NSS.

DEAN OF RESEARCH HOSTS SEMINAR SERIES

The Associate Provost and Dean of Research, Dr. Leonard Ferrari, is hosting a seminar series at NPS. The monthly venue will focus on relevant issues to the Navy and DoD and will cut across the spectrum of disciplines at NPS. The first two seminar speakers, Dr. Richard Claus, Hester Chair of Engineering at Virginia Tech on "Self Assembled Nanostructured Materials for Military Applications," and Capt Ryan Paterson, USMC, Defense Advanced Research Projects Agency, on "Command Post of the Future and the Adaptive Commander's Environment," were very well received.

The April speaker will be Dr. Ted S. Rappaport from the University of Texas, Austin. Dr. Rappaport is the William and Bettye Nowlin Chair in Engineering and is the founding director of the Wireless Networking and Communications Group at UT-Austin. He has 30 patents issued or pending and has authored, co-authored, and co-edited numerous books in the wireless field.

TECHNOLOGY REVIEW AND UPDATE SHORT COURSE OFFERED IN APRIL 2004

The Technology Review and Update is a short course designed for military, government and civilian technical personnel and decision makers interested in refreshing and updating their knowledge in important technical areas. The course is scheduled to run from 26 through 30 April 2004. The success and popularity of this short course is ensured by recruiting outstanding experts from industry, academia and the government and by constantly fine tuning the contents. The course provides an excellent overview and stresses the more practical aspects of the topics discussed. The tentative agenda is provided below:

- Internet Security – Opportunity or Oxymoron
  Dr. Roger R. Schell, President and CEO, Aesec Corporation
- Electro-Optical and Infrared Systems
  Distinguished Professor John Powers, Department of Electrical and Computer Engineering, Naval Postgraduate School
- The Future of Technology
  Dennis M. Bushnell, Chief Scientist, NASA Langley Research Center
- Micro-Electro-Mechanical Systems (MEMS)
  Professor Richard M. White, Electrical Engineering and Computer Science Department, UC Berkeley, Co-Director of Berkeley Sensor and Actuator Center
- Integrated Circuits
  Peter Alfke, Director of Applications Engineering, Xilinx, Inc.
- Bioengineering and Biotechnology
  Professor Dennis L. Polla, Department of Biomedical Engineering, University of Minnesota
- Military Satellite Communications Technology
  Austin Boyd, Sr., Space Systems Engineer, Science Applications International Corporation
- Satellite Communication Technologies and Trends
  Dr. James Stuart, President, IOSTAR Corporation, Inc.

Additional information and registration can be found at http://www.sp.nps.navy.mil/trau.html.

NPS FACULTY AWARDED PATENTS

Research at NPS can lead to a patentable idea. Three NPS faculty and an NPS student have recently been awarded an U.S. patent for their ideas.

Digital Signal Process Based Torpedo Countermeasure
U. S. Patent No. 6,600,694
LT Martin L. Whitfield, United States Navy
Associate Professor Donald R. Brutzman, Department of Information Science

Abstract: A system for producing a decoy to enable a target to avoid a homing torpedo that uses a sonar ping signal for homing in on the target comprises a transducer that operates in a receive mode in which it receives sonar signals and produces corresponding electrical signals and in a transmit mode in which it emits a sonar return pulse. A digital signal processor connected to the transducer is arranged to analyze the electoral signals corresponding to sonar signals received by the transducer and to determine whether they were emitted by the homing torpedo. The digital signal processor is further arranged to switch the transducer to the transmit mode in response to receipt of a sonar ping signal from the homing torpedo and to cause the transducer to transmit a return pulse that acts as a decoy signal to the homing torpedo.

False Target Radar Image Generator for Countering Wideband Imaging Radars
U.S. Patent No. 6,624,780
Professors Douglas J. Fouts and Phillip E. Pace, Department of Electrical and Computer Engineering

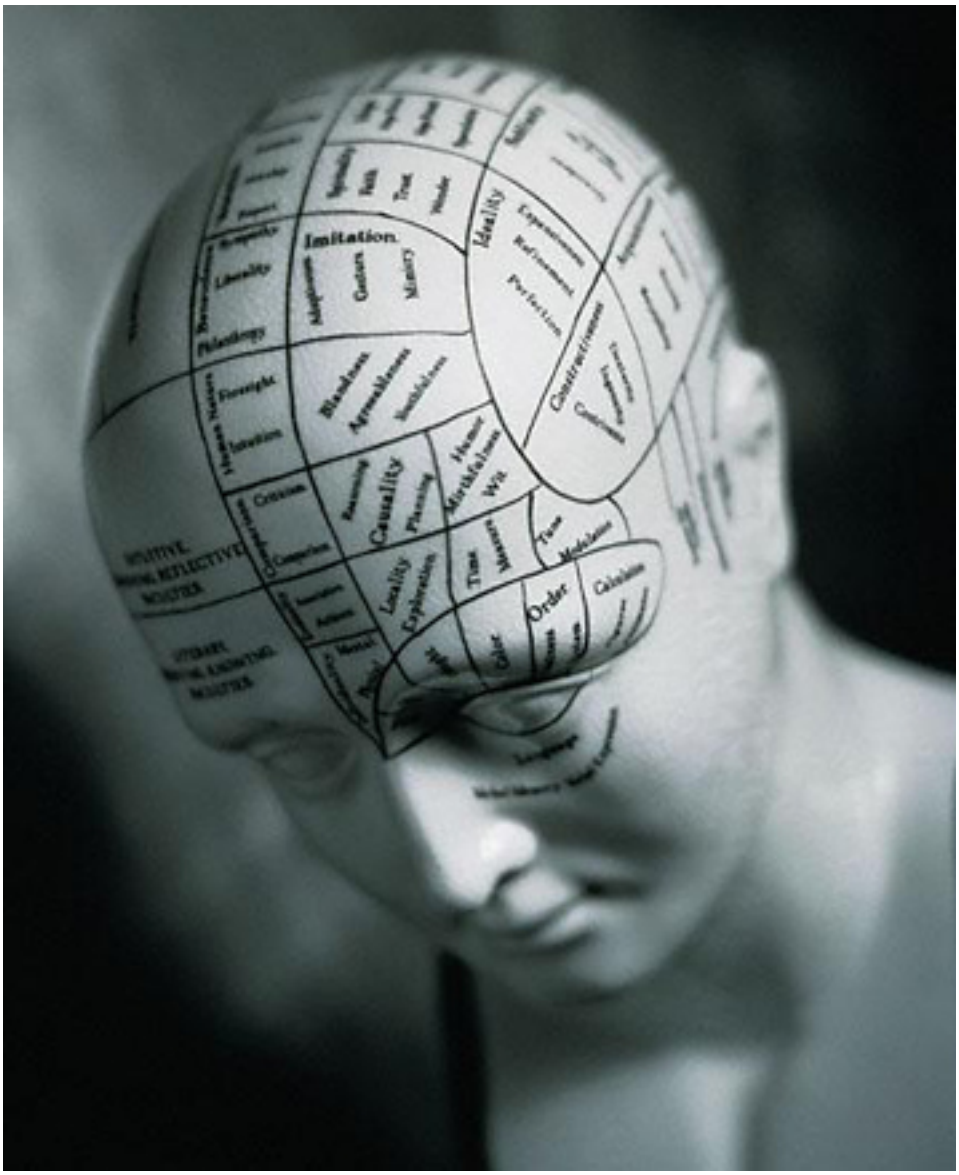
Abstract: A system for generating a false target radar image for countering wideband synthetic aperture and inverse synthetic aperture imaging radar systems to prevent a selected target from being detected by such radar systems comprises a receiver system for producing a digital sign that represents an incident radar signal. A phase sampling circuit is connected to the receiver for sampling the digital signal and providing phase sample data. An image synthesizer circuit is connected to the phase sampling circuit and arranged to receive the phase sample data therefrom. The digital image synthesizer circuit is arranged to process the phase same data to form a false target signal, which is input to a signal transmitter system arranged to transmit the synthesized false target signal so that it can be received by a radar system.

Dr. Pete Rustan, Director of the Advanced Systems and Technology (AS&T) Directorate at the National Reconnaissance Office, CAPT Dave Markham, Deputy Director of AS&T, Brian Hibbeln, Assistant Deputy Under Secretary of Defense for Special Capabilities, and Dan Kasmierski are shown with Professor Rudolf Panholzer touring the Small Satellite Development Facility in Bullard Hall. Dr. Rustan was visiting NPS to provide a seminar on the mission and top concerns of his organization and to review space-related research being performed by members of the Space Systems Academic Group.

CONFERENCES

PROTEUS MEDIA: EXPLORING THE UNKNOWN – LEARNING TO CREATE NEW MENTAL MODELS

The formation of a PROTEUS Consortium and the creation of PROTEUS Media, a research project, resulted from a two and a half day faculty research seminar in September 2003 sponsored by the National Geospatial-Intelligence Agency and hosted by the Cebrowski Institute.



PROTEUS originated as an advanced concepts research initiative at the U.S. National Reconnaissance Office in 1999-2000, employing commercially proven scenario-based methodology provided by The Futures Strategy Group LLC. In the course of exploring alternate future scenarios and considering possible national security issues, the project team[1] published interim results of the work in a book: *Proteus Insights from 2020.* The book has been used as a basis to enable further strategic research and has inspired the initiative of the PROTEUS Network and the PROTEUS Media Project.

This team identified ten PROTEUS perspectives, which offer the mind a new lens about the nature and directions of global change. Once the mind learns to use these perspectives, then the mind is better equipped to blend the conflicting mental models of global change. PROTEUS Media is follow-on research based on this work.

Continuing to nurture this emerging research, the Cebrowski Institute hosted the NSF-sponsored design workshop for PROTEUS Media, a computer-assisted political war-game. Organized by **Joanne Kim**, National Security Agency Cryptologic Innovation Chair, and Pamela Krause, futures researcher in InnoVision Directorate, Frontiers Office at NGA, attendees included:

- NPS faculty: **Professor Dorothy Denning** and **Associate Professors John Arquilla** and **Glenn Robinson,** Department of Defense Analysis, **Research Professor John Hiles**, Modeling, Virtual Environments and Simulation Institute; and **CAPT Steven Ashby, USN,** Department of National Security Affairs
- Army War College faculty: Professor William Waddell, Center for Strategic Leadership, Professor Cynthia E. Ayers, NSA Visiting Professor of Information Superiority
- National Research Council-Canada: Jack Smith, Leader, Office of Technology Foresight

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PROTEUS MEDIA: EXPLORING THE UNKNOWN, *continued from page 33*

- Office of the Director of Central Intelligence: William Nolte, Deputy Assistant DCI for Analysis and Reporting
- National Geospatial-Intelligence Agency: Robert Bridges, InnoVision Directorate, Frontiers Office
- George Washington University: Professor Leon Fuerth, Research Professor, Elliot School of International Relations (teleconference hookup)

The PROTEUS Media Project intends to use a PROTEAN world to explore the adaptive nature of human and group behavior in response to complex environmental forces and changes. In this world, there are opportunities for relationships between the actors and the ten PROTEAN perspectives (or insights). See below for the ten perspectives. In PROTEUS Media, these perspectives are called forces. These relationships can result in intended and unintended consequences throughout the PROTEAN world. A key goal of PROTEUS Media will be visualization, either during play or during after-action review of the interaction between the Protean forces and the assumptions, decisions, and actions of the Actors.

Contemporary Iraq will be used in this PROTEAN world. There is a rich array of entities, groups, constituencies, organizations, indigenous forms, external actors each with its own social, cultural, economic, political, geographic dimensions, continually interacting. Each of these entities has a presence in contemporary Iraq, whether physical, psychological or virtual. Their relationships with and among themselves change over time, causing their presence to morph into unforeseen influences. We propose research on how to discover and understand these new rational models and how to teach these to students. It is a complex world exhibiting a power law instead of linear relationships in terms of consequences, intended or not. We plan to implement a tabletop

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PROTEUS PERSPECTIVE

In world situations, there is a continual confluence of politics, newly formed nations, economics, environmentalism, social upheavals, biosciences and terrorism to mention a few. Fueled by technology and communications that are efficient, fast and cheaply available, the landscape of war and peace has changed forever. Small is powerful. Virtual life has become a form of reality. Going beyond the physical and terrestrial worlds, we see new opportunities for influence. They are space, spectral, psychological and virtual. Focusing on what is knowable may be more important than focusing on truth. Emergent forms of human behavior and thinking patterns are not quite undersood or appreciated. Within one chronological generation, technologies, human behaviors and thinking evolve multiple generations. In this milieu, time takes on increased importance because it is the one thing that these disparate actions across multiple planes have in common. They all sit on a timeline.

The PROTEUS approach can prepare and equip the minds of the military and civilian forces to enable them to increase the speed of military TRANSFORMATION and the REVOLUTION in intelligence. It opens the door to a knowledge harvesting strategy. Using the PROTEAN lens, the approach stretches the mind to permit the eye to recognize things it didn't see before and to comprehend the complexities of emergent forms of human behavior and thinking patterns. It is an innovative approach to helping us develop new rational models of complex worlds.

The PROTEUS approach offers a context for the uncertainties and an elaborate description of the resulting implications and environments that are being shaped by the emergent human behaviors and thinking. It offers a means to discover the unknown, to see what is not recognized, to understand the complex and to comprehend the consequences. PROTEUS provides a rational construction to explore the unknown. Using the new lens of the ten PROTEUS perspectives listed below, the propensity of threats to the stability and resilience of global culture and societies can be learned.

- Starlight: role and nature of time
- Sanctuary: propensity to hide in an open world
- Small stuff: software, biotechnology, nanotechnology, individuals and small groups
- Veracity: challenge to truth and knowledge
- Herds: mobility of people and ideas
- Wealth: beyond dollars
- Power: Clout: Who has it? What is it?
- Parallel Universe: from networks to cyber life
- Bedfellows: significance of teaming
- Threat-Opportunity: every threat is another's opportunity; a win sets in motion the opportunity for new loss.

PROTEUS MEDIA: EXPLORING THE UNKNOWN, *continued from page 34*

computer assisted political exercise employing the PROTEAN concepts applied to contemporary Iraq.

PROTEUS Media will put participants in governing positions inside individual factions that are operating within post-war Iraq. Each faction is a political entity capable of autonomous action. The game will give each faction leader experience in each of the PROTEUS Dimensions: political, economical, operational, cultural, and temporal. In particular, the temporal dimension will show the scale and pace of time and the presence of time pressure within a faction. In the aggregate, the game will provide experience in dealing with other operators who have a particularly different sense and scale of time. Faction leaders will also come to know the PROTEUS Forces. In PROTEUS Media these forces are adaptive and change based on the course of the war-game and on the attention or lack of attention players pay to the forces. These forces will be employed by the game to create surprises, power-law effects, and unintended consequences that spring from the actions taken by faction leaders. During this first phase of design, attention will focus on the relationship between temporal pace within a faction and that faction's interaction with an outside world, whose entities may possess intrinsic temporal scales that differ significantly.

The PROTEUS Media project will cover a preliminary design, detail design, development of software, training of facilitators, dry-run and, finally, demonstration of the resulting political war-game. The generic design will be used to play a political game exploring uncertainty in contemporary Iraq.

The next milestone is the PROTEUS Media Dry Run on 19-20 March. The National Research Council-Canada, Office of Technology Foresight, is hosting the event in Ottawa. Professor Arquilla is inviting specific players for the lead actor roles. Professor Hiles has technical lead in developing the political game. Pamela Krause from NGA, InnoVision Directorate, Frontiers Office is the PROTEUS mentor and advisor.

The consortium, called PROTEUS Net, is a largely informal and voluntary association of strategic foresight practitioners concerned with the challenges of anticipating and understanding global change, and exploring the related implications for intelligence and global security. The vision of PROTEUS is to build a network that can make practical and innovative contributions to a safer and more stable world through the development and sharing of advanced knowledge applications derived from insight and foresight.

PROTEUS network members are affiliated by a mutual recognition of collaborative opportunity and the prospective benefits and new vantage points offered by the leverage their diversity brings in terms of awareness, capabilities and elaboration and exploration of new ideas, technologies and methodologies for strategic foresight.

Anyone interested participating in PROTEUS Net activities, should contact either Joanne Kim, jbkim@nps.navy.mil or Pamela Krause, KrausePH@nga.mil .

Footnotes

[1] Original NRO PROTEUS Project Team: Pamela Krause, National Imagery and Mapping Agency; Charles W. (Tom) Thomas, The Futures Strategy Group, LLC; Michael S. Loescher, The Copernicus Group Inc.; Christopher Schroeder and Thomas Simpson, Northrop Grumman Information Technology; Thomas Witherell, General Dynamics.

SIXTH ANNUAL SYMPOSIUM: TECHNOLOGY AND THE MINE PROBLEM

The Naval Postgraduate School will host the Sixth Annual Symposium on Technology and the Mine Problem 9-13 May 2004. The purpose of the symposium is to continue the examination of the potentials of emergent technologies to enhance the capabilities of the U.S. and its Allies in mining, mine countermeasures, and humanitarian demining that includes area remediation. As with the five preceding symposia, this symposium is a joint undertaking of several U.S. Government Agencies.

This symposium will focus on enabling technologies that potentially support effective detection and clearance of sea and land mines and unexploded ordnance in military and humanitarian demining operations. Effective risk management in these operations is also addressed plus the latest information concerning mine design.

RADM John Pearson, USN (Ret.), Chair of Mine Warfare, and **Professor Clyde Scandrett**, Department of Applied Mathematics, are the NPS points-of-contact.

FACULTY ACHIEVEMENT

NPS PROFESSOR ELECTED TO METEOROLOGICAL SOCIETY POST

Chuck Wash

Professor Chuck Wash, Chairman of the Meteorology, has been elected to the governing council of the American Meteorological Society for a three-year term. Wash has been a leader in developing educational programs for civilian meteorologists and in observing Earth's weather patterns from the space shuttle in cooperation with NASA. He came to Monterey from the University of Wisconsin in 1980, and has been Chairman of the Meteorology Department since 1996.

NPS FACULTY HONORED AS FELLOWS IN PROFESSIONAL SOCIETIES

Charles N. Calvano

Professor Charles N. Calvano of the Mechanical and Astronautical Engineering Department has been awarded the status of Fellow of the Society of Naval Architects and Engineers. Professor Calvano has been a technical leader in ship research, development, test and evaluation, ship design, construction, repair and acquisition, and now education of the Navy's future technical leaders in the development of naval ships as a total system. Professor Calvano also serves as the Associate Director for Education in the Wayne E. Meyer Institute of Systems Engineering. Next year, Professor Calvano will begin a three-year tour as Associate Director for Systems Engineering and Ship Systems at the London Office of the Office of Naval Research (ONR Global).

Muguru Chandrasekhara

Research Professor Muguru Chandrasekhara of the Department of Mechanical and Astronautical Engineering has been honored as a fellow in the American Society of Mechanical Engineers. Dr. Chandrasekhara has made significant and numerous contributions to the understanding of the basic fluid flow physics of compressible dynamic stall, its onset mechanisms and control. His research on dynamic stall control using the novel concept of the dynamically deforming leading edge (DDLE) airfoil offers great potential in controlling many other types of flow separation, for a wide range of problems from wind turbines to RPVs. His development of the sophisticated, nonintrusive, quantitative flow visualization technique known as point diffraction interferometry (PDI) has enabled documenting complex fluid flows at a fine detail.

HALL OF FAME AWARD GOES TO DEFENSE ANALYSIS PROFESSOR

Dorothy Denning

Professor Dorothy Denning, Department of Defense Analysis, has received the Hall of Fame Award from the Information Systems Security Association (ISSA). The award is one of the highest honors available to information security professionals. Inductees are honored for their contributions to the information security community and their advancement of the profession. The 2003 ISSA Hall of Fame induction ceremony took place at the Association's Annual Meeting in New York in December. Started in 1998, the ISSA Hall of Fame recognizes an individual's contribution to the advancement of the information security profession. The ISSA has awarded this honor to only twelve other security professionals, including the most distinguished names in information security.

Professor Denning previously taught at Georgetown University, where she was the Callahan Family Professor of Computer Science and Director of the Georgetown Institute of Information Assurance. She has also worked at SRI International and Digital Equipment Corporation. Dr. Denning has published 120 articles and four books, her most recent being *Information Warfare and Security*. She is an ACM Fellow and recipient of several awards, including the Augusta Ada Lovelace Award and the National Computer Systems Security Award. In November 2001, she was named a Time magazine innovator. Her leadership positions have included President of the International Association for Cryptologic Research and Chair of the National Research Council Forum on Rights and Responsibilities of Participants in Network Communities.

FACULTY ACHIEVEMENT

NASA HONORS NPS PROFESSOR

The NASA Distinguished Service Medal was presented to **Professor Rudolf Panholzer**, Chairman of the Space Systems Academic Group, in recognition of his many years of distinguished service to NASA and the Nation's space program.

Dr. Panholzer has distinguished himself by furthering NASA's mission of inspiring the next generation of explorers through graduate education. Personally championing cooperation between NASA and the Naval Postgraduate School, he has initiated several programs, including the development of the PANSAT satellite. This one program alone involved 51 students' Masters-level theses over the period March 1989 until the satellite was launched during STS-95.

In 1995, he established the NASA Chair position at NPS, in honor of CAPT Michael J. Smith, USN, pilot of *Challenger* and one of the 33 astronaut-graduates of NPS. His leadership and cooperative programs with several NASA centers have resulted in hundreds of students working on thesis topics that involve NASA programs. Even before "jointness" and "interoperability" became popular, Dr. Panholzer has been a leader in cooperating with NASA realizing the mutual benefits of a strong NASA-NPS relationship.

Dr. Panholzer is currently leading the effort with NPS faculty and students to launch NPSAT1 in 2006.

CAPT Dan Bursch, USN with Dr. Rudolf Panholzer.

NATIONAL ACADEMY OF SCIENCE HONORS NPS PROFESSOR

Michael Zyda

MOVES Institute Director **Michael Zyda** was recently honored through a lifetime appointment to National Associate by the Council of the National Academy of Science. The award was bestowed in recognition of "extraordinary service" to the National Academy. Professor Zyda has served pro bono on National Research Council (NRC) committees since 1992, advising in many aspects of computing technology, most notably modeling and simulation.

Professor Zyda was a member of the NRC's behavioral and social-sciences commission committee on scientific and technological challenges in virtual reality, as well as a member of the aeronautics and space engineering board committee on advanced engineering environments. He was chairman of the aeronautics and space engineering board panel on computing, information, and communications technology (CICT) and member of the parent NRC committee for the review of NASA's pioneering revolutionary technology program. He also serves on the committee's panel for vehicle systems, which is part of the "Revolutionize Aviation" program. Professor Zyda is currently a member of the NRC Naval Studies Board Committee on FORCEnet Implementation Strategy.

In December 1996, Professor Zyda prompted the National Academy of Science to host a modeling-and-simulation workshop to explore cooperation between the entertainment industry and defense. Zyda's report and follow-up proposal stimulated the army in August 1999 to fund the Institute for Creative Technologies at the University of Southern California, supporting the application of entertainment software technology to military simulation, training and operations, and academic research. A few months later, Professor Zyda was authorized to launch a game-development project for the army at his newly inaugurated MOVES Institute. This project was *America's Army*, a PC game played over the internet that has become a huge success, both critically and as a strategic communications vehicle for the Army. Following its release in July 2002, *America's Army* became the fastest growing online game of all time, and today is the third-most-downloaded game in the world.

***America's Army: Special Forces (Ver. 2)* was the Editor's Choice in Computer Gaming Worlds "Game of the Year Awards" in the March 2004 issue. It was noted that "*America's Army* is now one of the best, if not the best, tactical sim to grace a computer."**

FACULTY ACHIEVEMENT

APPLIED MATHEMATICS PROFESSOR RECEIVES AWARD FOR EXCELLENCE IN SCIENTIFIC RESEARCH

Associate Professor Wei Kang of the Department of Applied Mathematics is the recipient of the 2003 Carl E. and Jessie W. Menneken Award for Excellence in Scientific Research. This annual award recognizes recent highly meritorious research having identifiable impact on Navy or DoD technology and is intended especially for the encouragement and benefit of younger faculty members.

Professor Kang's research is in three related areas of applied mathematics. The first is the normal form and invariants of nonlinear control systems. The second is the problem of bifurcation control of nonlinear systems. The third is in application of control theory to engineering problems, such as engine compressor control and formation control of unmanned aerial vehicles (UAVs). This last area of research is of critical importance to the Navy and DoD and is a major focus of his work.

Professor Kang's research has been supported the Air Force Office of Scientific Research and the Air Force Research Laboratory. These projects involved development of a feedback design for the control of nonlinear systems near bifurcation points.

Professor Kang's research is enhanced by interdisciplinary efforts with the engineering departments. A joint Aero-Math project funded by the Office of Naval Research involved recovery of the relative position and velocity between an aircraft and a carrier using the image from a camera installed on the aircraft. A collaboration with the Mechanical Engineering Department produced a paper on the stability of an underwater vehicle at low speed. Collaborative efforts with industry on DoD areas of interest have resulted in funding from the Ford Motor Company and Intel Corporation.

Wei Kang

Professor Kang has published more than sixty refereed technical papers in journals such as the *SIAM Journal of Control and Optimization* and the *IEEE Transactions on Automatic Control*. He is the technical editor of a book published by Springer in 2003.

Professor Kang has an international reputation in the community of nonlinear control and its applications. His work is strongly interdisciplinary and has application to several problems.

NPS' OPERATIONS RESEARCH TOPS NATIONAL RANKING

In a forthcoming article in the operations research journal, *Interfaces*, professors from the Operations Research (OR) Department and the Graduate School of Business and Public Policy have achieved the top ranking in the practice of OR. *Interfaces* is published by the Institute for Operations Research and the Management Sciences (INFORMS) and concentrates on the application of OR to real-world problems.

Every two years since 1996, Michael Rothkopf of Rutgers University has published in *Interfaces* a ranking of U.S. and international universities' contributions to OR practice. Each of the five rankings was based on the previous seven years of journal articles and columns concentrating on OR practice. Rothkopf notes that four universities have appeared in the top ten of all five of his rankings: MIT, Stanford, Temple and NPS. In the most recent ranking, NPS is tied for the top spot with the University of Virginia.

Professor Jim Eagle, Chairman of the NPS OR Department, says that, "Although Mike Rothkopf's grading system does not capture all of the OR publishing we do, including our classified work and publication in other good OR journals not considered by him, it's nonetheless very satisfying to be ranked by him as tied for first in the nation. For OR at NPS, it's all about the problem. If as practitioners we are not addressing significant decision problems of our most important resource and student sponsors, we are simply not earning our salaries. At NPS, we have been very fortunate over the years to have developed and maintained close contacts with those in DoD and industry facing complex strategic, operational and tactical problems. If you look at other successful programs across the country, they generally have similar close ties with industry and government to provide them with important, relevant applications. In my view, the best OR theory comes from OR practitioners

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FACULTY NEWS

GRADUATE SCHOOL OF BUSINESS AND PUBLIC POLICY

B.T. Baker, **S. P. Hocever** and B.W. Johnson, "The Prevalence and Nature of Service Academy Mentoring: A Study of Navy Midshipmen," *Military Psychology*, *15*(4): 272-283.

M. Boudreau and **B. Naegle**, *Reduction of Total Ownership Cost*, NPS-GSBPP-03-004, September 2003.

J. Dillard, *Centralized Control of Defense Acquisition Programs: A Comparative Review of the Framework from 1987 – 2003*, NPS-GSBPP-03-003, September 2003.

K. Doerr, T. Freed, T. Mitchell, C. Schriesheim and Z. Tracy, "Work Flow Policy and Within and Between Worker Variability in Performance," *Journal of Applied Psychology* (in press).

R. Franck and **F. Melese,** "A Game Theory View of Military Conflict in the Taiwan Strait," *Defense and Security Analysis*, Vol. 19, No. 4, pp. 327-348, December 2003.

W. R. Gates and **K. L. Terasawa**, "Reconsidering Publicness in Alliance Defense Expenditures: NATO Expansion and Burden Sharing," *Journal of Defense and Peace Economics*, pp. 369-383, October 2003.

K. Logemann**, B. Gates** and **M. Nissen**, "Simulation Analysis for Assignment Incentive Pay in the U. S. Navy Enlisted Personnel Assignment Process," INFORMS Annual Meeting, Atlanta, GA, 21 October 2003.

D. Henderson, "Is Freedom Contagious?" Mont Pelerin Society Regional Meeting, Chattanooga, TN, 19 September 2003.

Profs. S. Hocevar and **L. Sekerka** were invited participants in the Workshop on Transforming the Culture of the DoD, sponsored by the DoD Office of Force Transformation (OFT) (21-22 October 2003, Alexandria, VA). Different factors for transformation were discussed via lecture, breakout sessions, and in large group conversational exchanges. The meeting's purpose was to provide both intellectual exchange among defense and academic experts and specific recommendations for the Office of Force Transformation (OFT) as they begin to develop recommendations to present to the Secretary of Defense. Some of the topics discussed included: values and culture; core work processes; leadership; job design; reward and recognition; and management processes and systems. **S. Higgins** and the NPS Cebrowski Institute will be working with OFT on future efforts to extend this initial work.

R. Ibrahim and **M. Nissen**, "Emerging Technology to Model Dynamic Knowledge Creation and Flow among Construction Industry Stakeholders during the Critical Feasibility-Entitlements Phase," *Proceedings,* Joint Symposium on IT, CE, Nashville, TN, November 2003.

Prof. L. Jones delivered a presentation on Return-on-Investment (ROI) in the public sector and facilitated working groups tasked to develop a command ROI system at the Semi-Annual Conference of the Space and Naval Warfare Systems Command (SPAWAR) New Ship Construction C4I Division in San Diego on 2-3 December 2003.

Prof. L. Jones hosted the annual conference of the International Public Management Network at Asilomar 16-19 September 2003. Scholars from ten nations participated in the workshop portion of the conference. The conference theme was "New Technologies to Enable Capacity Building for Public Sector Reform." Prof. Jones also presented a paper at the IPMN conference titled, "Organizational Design as Technology for Public Sector Reform."

L. Jones, "Performance-Based Budget Review and Budget Reform in the US: An Update," *International Public Management Network Newsletter 7/3*, 2003: 1-6.

R.E. Levitt and **M. Nissen,** "The Virtual Design Team (VDT): A Multi-Agent Analysis Framework for Designing Project Organizations," *Proceedings,* International Conference on the Integration of Knowledge Intensive Multi-Agent Systems, Boston, MA, October 2003.

J. McCaffery and P. Godek, "Defense Supplementals and the Budget Process," *Public Budgeting and Finance*, Vol. 23, N. 2, Summer, 2003: 53-72.

J. McCaffery and **L. Jones**, *Budgeting and Financial Management for National Defense*, Information Age Publications, 2003.

T. Sass and **S. Mehay**, "Minority Representation, Election Method, and Policy Influence," *Economics and Politics*, Vol. 15, November 2003, pp. 323-340.

N. Roberts, "Direct Citizen

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NPS' OPERATIONS RESEARCH TOPS NATIONAL RANKING, *continued from page 38*

facing these challenging modeling and analysis problems."

The NPS professors publishing papers and columns contributing to this ranking were **Associate Professor Kevin Gue** from the Graduate School of Business and Public Policy, and **Associate Professor Rob Dell**, **Distinguished Professors Jerry Brown and David Schrady**, and **Professors Kevin Wood and Al Washburn** of the Department of Operations Research.

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Participation: Building a Theory," 7th National Public Management Research Conference, Georgetown Public Policy Institute.

J. Suchan, "Writing, Authenticity, and Knowledge Creation," Association for Business Communication Annual Conference, Albuquerque, NM, 23-25 October 2003.

R. Zolin, "Empirical research into the antecedents to trust in Military IPTs," presentation given to Defense Acquisition Career Management (DACM), Pentagon, October 2003.

R. Zolin, "Context changes everything: Empirical research into the antecedents to trust in different contexts," Stevens Institute of Technology, Hoboken, NJ, October 2003.

R. Zolin, "Context is everything: Empirical research into the antecedents to trust in different contexts," European Institute of Advanced Studies in Management (EIASM) Workshop on Trust Within and Between Organizations, October 2003.

GRADUATE SCHOOL OF ENGINEERING AND APPLIED SCIENCES

ELECTRICAL AND COMPUTER ENGINEERING

J. Butler and T. Sasao, "A Fast Method to Derive Minimum SOPs for Decomposable Functions," Asian South Pacific Automation Conference, Yokohama, Japan, 29 January 2003.

X. Yun, M. Lizarraga, E. Bachmann, and **R. McGhee**, "An Improved Quaternion-Based Kalman Filter for Real-Time Tracking of Rigid Body Orientation," IEEE/RSJ 2003 International Conference on Intelligent Robots and Systems, Las Vegas, NV, 27-31 October 2003.

Prof. X. Yun was elected as Vice-President for Finance of IEEE Nanotechnology Council, with a one-year term starting on 1 January 2004.

Prof. X. Yun was appointed as Treasurer of IEEE Robotics and Automation Society, with a two-year term starting on 1 January 2004.

METEOROLOGY

Prof. C. P. Chang was named as the Chairman of the International Panel on East Asian Monsoon by the World Meteorological Organization, effective 1 January 2004.

Prof. C. P. Chang was honored as one of six Hong Kong Observatory 120th Anniversary Distinguished Meteorologists. Other U.S. scientists honored were Dr. William Lau, Chief of Laboratory for Atmospheres, NASA Goddard Space Flight Center, and Dr. Gabriel Lau, Professor of Atmospheric Sciences, Princeton University. Professor Chang received the award and delivered a Distinguished Lecture at the Hong Kong Science Museum on 19 October 2003.

Prof. P. Durkee presented two posters describing classified research results at the MASINT – A Catalyst for Transformation Conference held at the National Reconnaissance Office, 9-11 December 2003.

The Meteorology Department hosted AFOTEC (Air Force Operational Test and Evaluation Center) as they conducted a Military Utility Assessment exercise for the COMWX (Computerized Operational MASINT Weather) ACTD (Advanced Concept Technology Demonstration). **P. Durkee** and **K. Nielsen** with help from students **Nick Vincent** and **Vic Ross**, prepared computers, data and application software for use during the assessment. METOC students and researchers from NRL-Monterey participated in the assessment exercise as evaluators of the COMWX ACTD.

D. Miller, "Real-Time Mesoscale Model Forecasting at the Naval Postgraduate School," The Future of Regional Real-Time Numerical Weather Prediction Workshop, 11-12 December 2003, Boulder, CO.

D. Sullivan, J. Zande, S. Butcher, **T. Murphree**, and Bruce Ford, "Using Marine Technology to Teach Ocean Literacy and Workplace Competencies," *Current, The Journal of Marine Education*, Vol. 19, No. 2, p. 23-35, 2003.

T. Murphree, B. Ford, F. Schwing, S. Bograd, and R. Mendelssohn, "Dynamic Similarity in Large Scale Climate Variations of the Northeast Pacific and Northwest Atlantic," *Eos Transactions,* American Geophysical Union, 84(52), 2004.

T. Murphree, **C. Wash**, J. Hinz, P. Vodola, and D. Simms, "Developing and Applying METOC Metrics for Sea Strike Operations," Rapid Transition Program Workshop, SPAWAR, San Diego, CA, November 2003.

W. Nuss, "Mesonet Observations and Applications in the Central California Region," Design and Development of Multifunctional Mesoscale Observing Networks in Support of Integrated Forecasting Systems Workshop, 8-10 December 2003, Boulder, CO.

OCEANOGRAPHY

P.C. Chu and C.W. Fan, A. D., 2003: Three-dimensional rigid body impact

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burial model. *Advances in Fluid Mechanics*, 6, in press.

P.C. Chu, M. D. Perry, E. L. Gottshall, and D. S. Cwalina, 2003: Satellite data assimilation for improvement of Naval undersea capability. *Marine Technology Society Journal*, in press.

Prof. P.C. Chu was the Scientific Advisor for the International Symposium on Clean Environment, 21-22 November 2003, Cheonan, Korea.

P.C. Chu and S.H. Lu, Second kind predictability in climate models. International Symposium on Clean Environment, 21-22 November 2003, Cheonan, Korea (invited paper).

P.C. Chu and C.W. Fan, A terrain-following finite volume ocean model. Eighth International Conference on Estuarine and Coastal Modeling (ECM8), 3-5 November 2003, Monterey, CA.

P.C. Chu, Multifractal thermal characteristics and nonlinear dynamics of the Southwestern GIN Sea upper layer. American Geophysical Union Fall Meeting, 8-12 December 2003, San Francisco, CA.

P.C. Chu, L. M. Ivanov, and O. Melnichenko, Fall-winter synoptic current reversal on the Louisiana-Texas continental shelf, American Geophysical Union Ocean Sciences Meeting, 26-30 January 2004, Portland, OR.

P.C. Chu and L. M. Ivanov, How long can an ocean model predict? American Geophysical Union Ocean Sciences Meeting, 26-30 January 2004, Portland, OR.

Pickett, M., and **J.D. Paduan**, 2003: Wind stress curl and related upwelling in the California Current System from high resolution COAMPS reanalysis fields. *J. Geophys Res.*, 108, 25-1 to 25-10.

J.D. Paduan and I. Shulman, 2003: CODAR data assimilation in the Monterey Bay area. *J. Geophys Res.*, in press.

PHYSICS

Prof. R. Brown continued participation in the Executive Committee of the International Ballistics Committee and was elected Bursar for period 2003 to 2007.

Prof. R. Brown hosted and chaired recent NDIA Joint Classified Ballistics and Warheads Symposium at NPS in June 2003.

Prof. R. Brown is a member of the NDIA Ballistics and Steering Committee.

N. M. Haegel, J.D. Fabbri and M.C. Coleman, "Direct Transport Imaging in Planar Structures," *Applied Physics Letters,* February 2004.

Prof. N. Haegel received the 2004 American Physical Society Prize given to a Faculty Member for Research at an Undergraduate Institution.

T. Phua, T. Moore, R. Brown, "Quantitative Code Evaluation for Predicting Shaped Charge Jet Stability and Characteristics," 21st International Symposium on Ballistics, Adelaide, Australia, April 2004.

R. Umstattd and **B. Carter** "Experiments on SCADA System Vulnerability to Directed Energy Attack," Directed Energy Professional Society's 6th Annual Symposium in Albuquerque, NM.

R. Umstattd and **C. Schlise**, "An Explosive Emission Cathode in a Thermionic Cathode Environment," 45th Annual Division of Plasma Physics Meeting of the American Physical Society, Albuquerque, NM.

B. Hibbeln, a research associate working in the Department of Physics has been selected for a job as the Assistant Deputy Under Secretary of Defense for Special Capabilities, working under Ms. Sue Payton, DUSD for Advanced Concepts and Technology (DUSD AC&T). The new appointment takes effect in February 2004.

GRADUATE SCHOOL OF OPERATIONAL AND INFORMATION SCIENCES

COMPUTER SCIENCE

D. Drusinsky, "Monitoring Temporal Rules Combined with Time Series," *Proceedings,* 2003 Computer Aided Verification Conference (CAV), pp. 114-117.

D. Drusinsky and G. Watney, "Applying Run-Time Monitoring to the Deep-Impact Fault Protection Engine," 28th IEEE/NASA Software Engineering Workshop, 2003.

D. Drusinsky and J. Fobes, "Real-time, On-line, Low Impact, Temporal Pattern Matching," 7th World Multiconference on Systemics, Cybernetics and Informatics, Orlando FL, 2003, pp. 345-348.

C. Artho, **D. Drusinsky**, A. Goldeberg, K. Havelund, M. Lowry, C. Pasareanu, G. Rosu, and W. Visser, "Experiments with Test Case Generation and Runtime Analysis," 10th International Workshop on Abstract State Machines, Sicily, Italy, 2003 (invited).

D. Drusinsky and K. Havelund, "Execution-Based Model Checking of Interrupt-Based Systems, Workshop on Model-Checking for Dependable Software-Intensive Systems," International Conference on Dependable Systems and Networks, San Francisco, CA, 2003.

D. Drusinsky and **M. Shing**, "Verification of Timing Properties in Rapid System Prototyping," *Proceedings, Rapid System Prototyping Conference 2003* (RSP'2003).

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FACULTY NEWS

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G. Brat, **D. Drusinsky**, D. Giannakopoulou, A. Goldberg, H. Klaus, M. Lowry, C. Pasareanu1, A.Venet, W. Visser, and R. Washington, "Experimental Evaluation of Verification and Validation Tools on Martian Rover Software," *Journal of Formal Methods in Systems Design*, (in press).

D. Drusinsky and **M. Shing**, "Monitoring Temporal Logic Specifications Combined with Time Series Constraints," *Journal of Universal Computer Science (JUCS)*, Vol. 9, No. 11 (2003), 1261-1276.

R. Mohan, **T. Levin** and **C. Irvine**, "An Editor for Adaptive XML-Based Policy Management of IPSEC," Annual Computer Security Applications Conference (ACSAC), 8-12 December 2003, Las Vegas, NV.

S. Ubhayakar, **D. Bibighaus**, **G. Dinolt**, **T. Levin**, "Evaluation of Program Specification and Verification Tools for High Assurance Development," International Workshop on Requirements for High Assurance Systems, IEEE International Requirements Engineering Conference, 9 September 2003, Monterey, CA.

C. Irvine, "Considering Lifecycle Subversion," and "Monterey Security Architecture (MYSEA)," ASD/NII Information Assurance Directorate, Office of the Secretary of Defense Multilevel Security Workshop, 25-26 September 2003.

Prof. C. Irvine participated in an invitational workshop on Grand Challenges in Information Assurance sponsored by the Computing Research Association and the National Science Foundation, 16-19 November 2003.

C. Irvine, "Naval Postgraduate School Information Assurance Research and Development," DoD Information Assurance Research and Development Symposium, 3-5 December 2003.

DEFENSE ANALYSIS

G. Robinson, *Building a Successful Palestinian State*, Santa Monica: RAND, forthcoming 2004.

G. Robinson, "Being Yasir Arafat: A Portrait of Palestine's President," *Foreign Affairs*, Vol. 82, No. 6 (November/December *2003).*

G. Robinson, "Las perspectives de la democracia," *Vanguardia Dossier* No. 8 (October-D*ecember 2003) Spai*n.

G. Robinson, "Crisis in Palestine," *Strategic Comments*, Vol. 9, No. 7 (September 2003), IISS, London.

G. Robinson, "The Al-Aqsa Intifada," David W. Lesch, ed., *History in Dispute: The Middle East Since 1945*, Volumes I and II. Columbia, S.C.: Manly, 2003 and 200*4.*

G. Robinson, "Why Oslo Failed," David W. Lesch, ed., *History in Dispute: The Middle East Since 1945*, Volumes I and II. Columbia, S.C.: Manly, 2003 and 2004.

G. Robinson, "Arab East Jerusalem," David W. Lesch, ed., *History in Dispute: The Middle East Since 1945*, Volumes I and II. Columbia, S.C.: Manly, 2003 and 2004.

G. Robinson, "The First Palestinian Intifada, 1987-93," David W. Lesch, ed., *History in Dispute: The Middle East Since 1945*, Volumes I and II. Columbia, S.C.: Manly, 2003 and 2004.

G. Robinson, "Hamas as Social Movement," in Quinten Wiktorowicz, ed., *Social Movement Theory and Islamic Fundamentalism*, Indiana University Press, 2003

G. Robinson, "The Palestinian 'Intifada' Revolt," in Jack A. Goldstone, *Revolutions: Theoretical, Comparative and Historical Studies*, Thomson-Wadsworth, 3rd Edition, 2003.

G. Robinson, "Typologies of Islamist Networks," Annual Conference of the Middle East Studies Association, Anchorage, AK, November 2003.

INFORMATION SCIENCE

W. Baer, along with co-authors T. Campbell and B. Powell (OTC Ft. Hood , TX), won first prize for their paper titled, "Accommodating Terrain Error and Vegetation Layer in a Statistical Line-of-Sight Algorithm," Test and Evaluation of Advanced Technology Systems Meeting, conducted by ITEA in Lihue, Kauai, HI.

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Senior Lecturer David Olwell of the Department of Operations Research received the **Department of the Navy Superior Civilian Service** Award on 8 January, 2004, for his contributions to the System Engineering and Analysis curriculum, the Systems Analysis certificate program, and the Operations Research Department. This is a significant award recognizing Olwell's nonstop, selfless service to NPS mission in several areas.

David Olwell

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T. Housel, "Estimating the Top Line in E-Business," International Conference on Electronic Commerce, Pittsburg, PA, 2 October 2003.

P. A.Smart; R. Maull, Z. Radnor, and **T. Housel,** "An Approach for Identifying Value Business Processes," *Journal of Knowledge Management*, 2003, Vol. 7, No. 4, 2003, pp. 49-61 (DOI: 10.1108/13673270310492949).

N. Schneidewind, "Modeling the Fault Correction Processes," *The R & M Engineering Journal, American Society for Quality*, 2003 December, Vol. 23, No. 4, (ISSN 0277-9633), Part 1, pp. 6-15.

N. Schneidewind, "Fault Correction Profiles," *Supplementary Proceedings of the 14th International Symposium on Software Reliability Engineering*, Denver, CO, 17-20 November 2003, pp. 257-267.

N. Schneidewind "Application of IEEE Standard Dictionary of Measures of the Software Aspects of Dependability," *Supplementary Proceedings of the 14th International Symposium on Software Reliability Engineering*, Denver, CO, 17-20 November, 2003, pp. 129-134.

J. Voas and **N. Schneidewind,** "Marrying Software Fault Injection Technology Results with Software Reliability Growth Models," *Supplementary Proceedings of the 14th International Symposium on Software Reliability Engineering*, Denver, CO, 17-20 November 2003, pp. 230-231.

N. Schneidewind, "Applying Fault Correction Profiles," 28th NASA/ IEEE Software Engineering Workshop, 3-4 December 2003, Greenbelt, MD.

N. Schneidewind, "Software Acquisition Life Cycle Measurement Plan based on the revised 'IEEE P1633\AIAA R-013A Recommended Practice on Software Reliability'," Workshop on Software Assessment, 14th International Symposium on Software Reliability Engineering, Denver, CO, 17-20 November 2003.

N. Schneidewind, Panelist: "Everything You Wanted to Know About Software Reliability Engineering But Didn't Know Who to Ask," 14th International Symposium on Software Reliability Engineering, IEEE Computer Society Press, Denver, CO, 17-20 November, 2003.

OPERATIONS RESEARCH

J. Brown, M. Carlyle, K. Wood and **J. Salmeron,** "How to Build a Robust Supply Chain, or Harden the One You Have," Informs, Atlanta, GA, October 2003.

J. Salmeron, K. Wood and R. Baldick, "Analysis of Electric Grid Security Under Terrorist Threat," *IEEE Transactions on Power Systems* (accepted for publication).

Prof. P. Sanchez was one of the two Proceedings Co-Editors for the 2003 Winter Simulation Conference (WSC). WSC <http://www.wintersim.org> is the premier annual conference for researchers and professionals in the field of Discrete Event Simulation and was held in New Orleans, LA, 7-10 December 2003.

S. Sanchez and E. Wolf, "Agent-based Models for Expeditionary Logistics," INFORMS Annual Meeting, Atlanta, GA, 19-22 October 2003.

S. Sanchez and H. Wu, "Frequency-Based Experiments for Terminating Simulations: A Peace-Enforcement Example," *Proceedings of the 2003 Winter Simulation Conference*, eds. S. Chick, P. J. Sanchez, D. Ferrin, and D. J. Morrice, Institute of Electrical and Electronic Engineers: Piscataway, NJ, 952-959.

E. S. Wolf, **S. Sanchez**, N. Goerger and L. P. Brown, "Using Agents to Model Logistics," 71st MORS Symposium, 10-12 June 2003. [Paper has been nominated for the Richard H. Barchi Prize by the Military Operations Research Society (MORS).]

SCHOOL OF INTERNATIONAL GRADUATE STUDIES

DEFENSE RESOURCES MANAGEMENT INSTITUTE

A. Richter, S. Anton, P. Koch, and S. Dennett (2003), "The Impact of Reducing Dose Frequency on Health Outcomes," *Clinical Therapeutics* 25(8); pp 2307-35.

NATIONAL SECURITY AFFAIRS

G. Christoffersen, "An International Public Goods Theory of ASEAN+3," *International Relations of the Asia Pacific Region after 9.11 and China's Accession to WTO*, ed. Wang Xinsheng (Beijing: Chinese Academy of Social Sciences, 2003).

G. Christoffersen, "Xinjiang" and "Heilongjiang," *Das grosse China-Lexicon*, ed. Brunhild Staiger (Darmstadt: Wissenschaftliche Buchgesellschaft, 2003).

K. Gutteiri, "The Civil Dimension of Strategy," *Humanizing Our Global Order*, ed. Obiora Chinedu Okafor and Obijiofor Aginam (Toronto: University of Toronto Press, 2003), 87-111.

K. Gutteiri, P. Suedfeld, and P. Tetlock, "Archival Analyses of Thinking and Decision-Making: Assessing Integrative Complexity at a Distance," *The Psychological Assessment of Political Leaders: Method and Application*, ed. Jerrold M. Post (Ann Arbor: University of Michigan Press, 2003), 246-70.

K. Gutteiri, "Homeland Security and U.S. Civil-Military Relations," CCC *Strategic Insight*, August 2003.

K. Gutteiri, "Post-Conflict Iraq: Prospects and Problems," CCC *Strategic Insight*, February 2003.

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K. Gutteiri, "Critical Incident Effects: The US Military, Strategic Culture, and September 11," European Consortium for Political Research, Marburg, Germany, 17-21 September, 2003.

K. Gutteiri, "Passage of Lines: Civil-Military Issues in Stability Operations," discussion memo for Workshop on Military Effectiveness, Northwestern University, 11-12 April 2003.

K. Guitteiri, "Civil-Military Relations and 'Effective' Civil-Military Operations," Annual Meeting of the International Studies Association Portland, OR, 29 February 2003.

F. Khan, "The Independence- Dependence Paradox: Stability Dilemmas in South Asia," *Arms Control Today* (October 2003).

P. Lavoy, "Managing South Asia's Nuclear Rivalry: New Policy Challenges for the United States," *The Nonproliferation Review*, Vol. 10, No. 3 (Fall-Winter 2003): 84-94.

P. Lavoy, "The Enduring Effects of Atoms for Peace," *Arms Control Today*, Vol. 33, No. 10 (December 2003): 26-30.

P. Lavoy, "Pakistan," *Proliferation Challenges after Iraq*, ed. Robert S. Litwak and Mitchell Reiss (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2003).

P. Lavoy and S. Smith, "The Risk of Inadvertent Nuclear Use Between India and Pakistan," *NBC Report* (a journal of the U.S. Army Nuclear and Chemical Agency) (Spring/Summer 2003), 25-29.

P. Lavoy and S. Smith, "The Risk of Inadvertent Nuclear Use between India and Pakistan," CCC *Strategic Insight* (February 2003).

L. Lawson, "Globalisation and the African State," *Commonwealth and Comparative Politics* 41, No. 3 (November 2003): 37-58.

R. Looney, "Oil Prices and the Iraq War: Market Interpretations of Military Developments," *Journal of Energy and Development* 23, No. 1 (Autumn 2003): 25-42.

R. Looney, "The Neoliberal Model's Planned Role in Iraq's Economic Transformation," *Middle East Journal*, Fall 2003.

R. Looney, "Reforming Pakistan's Educational System: The Challenge of the Madrassas," *The Journal of Social Political and Economic Studies*, Fall 2003.

R. Looney, "Bean Counting in Baghdad: Debt, Reparations, Reconstruction and Resources," *Middle East Review of International Affairs*, September 2003.

R. Looney, "A Monetary/Exchange Rate Strategy for the Reconstruction of Iraq," *Middle East Policy*, Fall 2003.

R. Looney, "Problems in Using International Trade to Counter Terrorism: The Case of Pakistan," *Journal of South Asian and Middle Eastern Studies*, Summer 2003.

R. Looney, "The Gulf Co-operation Council's Cautious Approach to Economic Integration," *Journal of Economic Cooperation*, April 2003.

R. Looney, "Hawala: The Terrorists' Financial Mechanism," *Middle East Policy*, Spring 2003.

C. Manning and M. Antic, "Lessons from Bosnia and Herzegovina: The Limits of Electoral Engineering," *Journal of Democracy* 14, No. 3 (July 2003): 45-59.

C. Manning, "Local Level Challenges to Post-conflict Peacebuilding," *International Peacekeeping* 10, No. 3 (Autumn 2003): 25-43.

C. Manning, "Elections and Political Change in Post-War Bosnia and Herzegovina," *Democratization*, 11/2 (April 2004), 60-66 (forthcoming).

C. Manning, "Armed Opposition Groups into Political Parties: Lessons from Bosnia, Kosovo, and Mozambique," *Studies in Comparative International Development*, 2004 (forthcoming).

C. Manning, "Party Systems in Africa after the Third Wave," *Party Politics*, 2004 (forthcoming).

D. Moran and A.Waldron, eds., *The People in Arms: Military Myth and National Mobilization Since the French Revolution* (Cambridge: Cambridge University Press, 2003).

D. Moran, "Germany," *Researching World War I: A Handbook*, ed. Robin Higham (Praeger, 2003).

D. Moran, "Restraints on Violence and the Reconstruction of International Order after 1945," *War and Terror in Historical and Contemporary Perspective*," ed. M. Geyer, *American Institute for Contemporary German Studies, Harry and Helen Gray Humanities Series*, Vol. 14 (2003).

M. Morgan, "Administrative Reforms in China," Krishna K. Tummala ed., *Comparative Bureaucratic Systems* (Lexington Books, 2003), 337-54.

E. Olsen, "A Korean Solution to the United States' Korean Problem," *Journal of East Asian Affairs*, Fall/Winter 2003.

E. Olsen, "Homeland Security, Defending America First," *Chronicles*, December 2003.

E. Olsen, "The United States and the Korean Peace Process," *The Korean Peace Process and the Four Powers*, eds. T. H. Kwak and S. H. Joo (Aldershot: Ashgate Publishing, 2003).

J. Piombo, "The Import of Nigeria's April 2003 Elections," CCC *Strategic Insight* (June 2003).

J. Piombo, "Political Institutions, Social Demographics and the Decline of Ethnic Mobilization in South Africa, 1994 - 1999," Centre for Social Science Research of the University of Cape Town, South Africa, 13 November 2003.

J. Piombo, "Political Institutions,

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Social Divides and Racialized Politics in South Africa," *Party Politics,* May 2004 (forthcoming).

J. Piombo, "Election 2004 South Africa: Issues, Debates and Implications for Democracy," Africa Table Seminar Series, Stanford University Center for African Studies, 3 December 2003.

S. Rana, "Massoud Ahmed Shah," *Encyclopedia of World Terrorism* (M.E. Sharpe, 2003), 188-90.

S. Rana, "Taliban," *Encyclopedia of World Terrorism* (M.E. Sharpe, 2003), 221-24.

S. Rana, "Kashmir," *Encyclopedia of World Terrorism* (M.E. Sharpe, 2003), 469-73.

S. Rana, "North Korea," *Encyclopedia of World Terrorism* (M.E. Sharpe, 2003), 478-80.

J. Russell, "Searching for a Post Saddam Middle East Security Architecture," *Middle East Review of International Affairs*," 7 No. 3 (March 2003).

J. Russell, "Saudi Arabia 2008," Centra Technologies, September 2003 (not available for public release).

J. Russell, "Formation of the Iraqi Political System: Role of the Gulf Cooperation Council," *Emirates Center for Strategic Studies and Research Lecture Series* (November 2003).

J. Russell and **J. Wirtz,** "Preventive War and Preemption: Reassessing the U.S. Policy Toward Iraq and the War on Terrorism," *Non-Proliferation Review* (Spring 2003).

J. Russell, "In Defense of the Nation: Reform and Terror in Saudi Arabia," CCC *Strategic Insight* (October 2003).

J. Russell, "Occupation of Iraq: Geostrategic and Institutional Challenges," CCC *Strategic Insight* (August 2003).

J. Russell, "Political and Economic Transition on the Arabian Peninsula: Perils and Prospects," CCC *Strategic Insight* (May 2003).

J. Russell, "Removal of Saddam: End of An Era," CCC *Strategic Insight* (February 2003).

B. Salmoni, "Turkish Knowledge for a Modern Life: Innovative Pedagogy and Nationalist Substance in Primary Schooling, 1927-1950," *Turkish Studies Journal* 4:3 (2003).

B. Salmoni, "Women in the Nationalist-Educational Prism: Turkish and Egyptian Pedagogues and their Gendered Agenda, 1920-1952," *History of Education Quarterly* 43:4 (2003).

B. Salmoni, "Electoral Survival of the Corruptest? Azerbaijan, Georgia, and American Regional Goals," CCC *Strategic Insight* (December 2003).

B. Salmoni, "Turkey's Summer 2003 Legislative Reforms: EU Avalanche, Civil-Military Revolution, or Islamist Assertion?" CCC *Strategic Insight* (Sept. 2003).

B. Salmoni, "The Roadmap: a Phased Vision for Israel and Palestine," CCC *Strategic Insight* (August 2003).

B. Salmoni, "Strategic Partners or Estranged Allies: Turkey, the United States, and Operation Iraqi Freedom," CCC *Strategic Insight* (July 2003).

M. Tsypkin, "Rudderless in a Storm: The Russian Navy, 1992-2002," *Russian Military Reform, 1992-2002*, eds. Anne C. Aldis and Roger N. McDermott (London: Frank Cass, 2003), 162-86.

M. Vann, "Of Rats, Rice, and Race: The Great Hanoi Rat Massacre, an Episode in French Colonial History," *French Colonial History Society* (May 2003).

M. Vann, "The Good, the Bad, and The Ugly: Variation and Difference in French Racial Thinking in Colonial Vietnam," *The Color of Liberty: The History of Race in France*, eds. Tyler Stovall and Sue Peabody (Duke University Press).

J. Wirtz, "Theory of Surprise," *Paradoxes of Strategic Intelligence*, eds. Richard K. Betts and Thomas G. Mahnken (London: Frank Cass: 2003).

J. Wirtz, "Ethics and the Return to Strategy," *Civil-Military Aspects of Military Ethics*, eds. Edwin R. Micewski (Vienna: National Defense Academy, 2003).

J. Wirtz, "Will Globalization Sink the Navy?" *Globalization and Maritime Power*, ed. Sam Tangredi (Washington, D.C.: NDU Press, 2003).

D. Yost, "Debating Security Strategies," *NATO Review* (Winter 2003), available at http://www.nato.int/docu/review/2003/issue4/english/art4.html.

D. Yost, "The U.S.-European Capabilities Gap and the Prospects for ESDP [European Security and Defense Policy]," *Defending Europe: The EU, NATO and the Quest for European Autonomy*, ed. Jolyon Howorth and John T. S. Keeler (New York: Palgrave Macmillan, 2003), 81-106.

D. Yost, "Alliance Relations and Concepts of Assurance, Deterrence, and Dissuasion," Fifth Nuclear Stability Round Table on Strategic Stability in a Turbulent World, McLean, VA, 28 April 2003.

D. Yost, "Implications for Europe and NATO," a paper presented at the conference on Nuclear and Conventional Forces: Issues for National Security, Science and Technology, Los Alamos National Laboratory, Los Alamos, NM, 1 May 2003.

D. Yost, "France's Nuclear Deterrence Strategy: Concepts and Operational Implementation," Conference on Getting MAD: Nuclear Mutual Assured Destruction, Its Origins and Practice, Washington, D.C., 12 May 2003.

D. Yost, "U.S. Strategic Concepts: Implications for NATO," Conference on Transatlantic Relations at a Crossroads, Amsterdam, The Netherlands, 19 June 2003.

ATMOSPHERIC IMPACTS ON 'SEA SHIELD', *continued from page 6*

high resolution forecasts of local flow patterns and turbulence events for several DoD sponsors using a computer weather model that has been tuned based on observations of atmospheric turbulence made around the globe. They have been able to provide these turbulence forecasts throughout the period of an extended classified operational test and have used the feedback from this experience to further improve the computer weather model. An example of computer model forecasts and verification of integrated atmospheric turbulence is given in Figure 7. Additional new prediction techniques are now being developed. Air Force Research Laboratory, Phillips Lab, and classified sponsors are supporting their work.

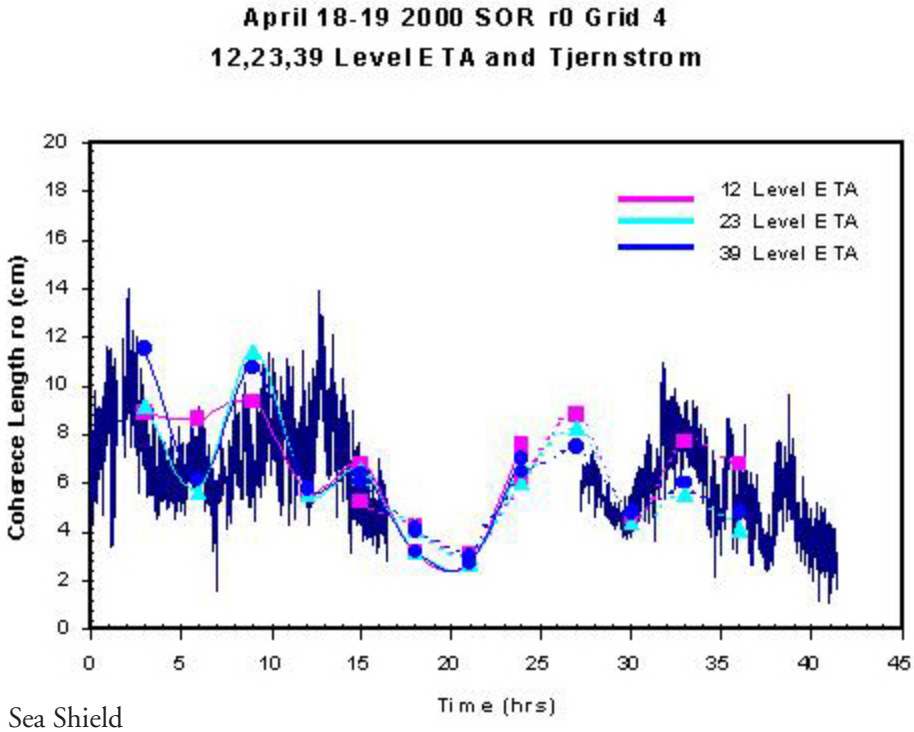
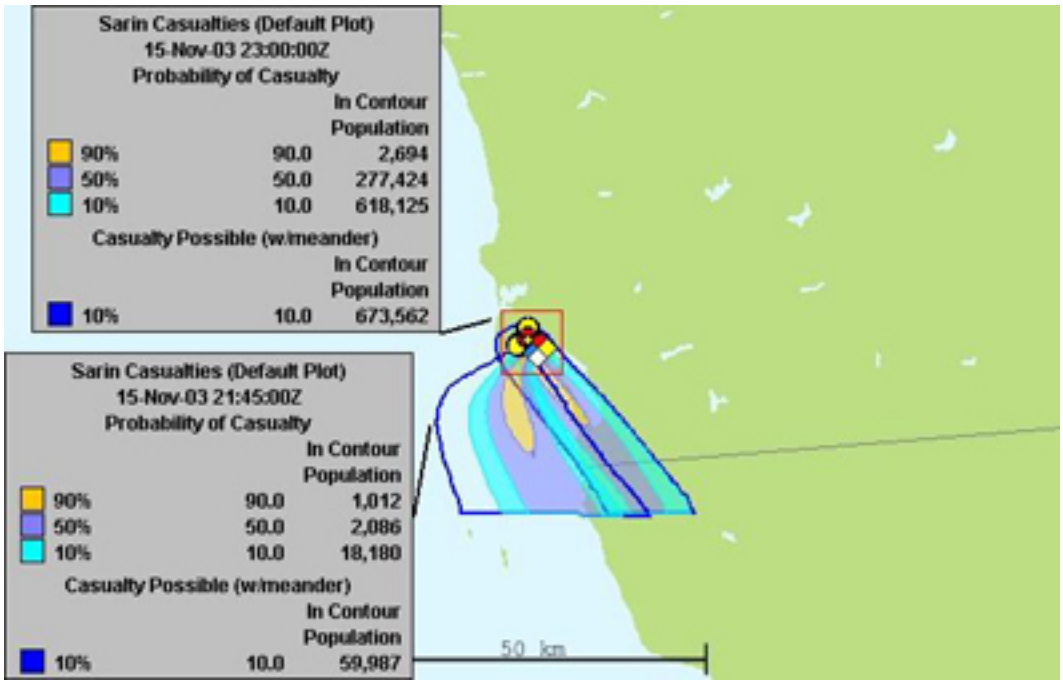


Figure 7. Predicted and measured atmospheric turbulence for 40 hour period.

Figure 8. Forecasts of Dispersion with and without local data assimilation for simulated attack near San Diego, CA.



Atmospheric Dispersion of Hazardous Agents

Another new critical forecast requirement from Sea Shield within the war on terror is the need to prepare quickly operational dispersion assessments in the event of the use of weapons of mass destruction or hazardous substances. This is another challenging assignment as the atmospheric dispersion is governed by the local wind flow and vertical stability. Under the guidance of **Professor Carlyle Wash** and with the support of SPAWAR San Diego, **LCDR Victor Ross, USN**, used a new environmental database to test dispersion forecasts. They prepared these forecasts with and without local, non-conventional data, and within rigid time constraints. Their work revealed the importance of assimilating local continuous data into the forecast to improve the quality of the dispersion plume prediction. Examples of differences of plume forecasts with and without local data are given in Figure 8.

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MOVES INSTITUTE DEMONSTRATES TECHNOLOGIES FOR MODELING, *continued from page 19*

computational tools that can be used by deployed military analysts to plan and monitor Military Operations Other Than War (MOOTW). NPS is working with the FAST government/contractor team to enhance capabilities for interchange of static scenario definition data across the family of simulation models using common vocabularies such as XML representations of the Command and Control Information Exchange Data Model (C2IEDM) and Battlespace Management Language (BML). **CPT Glenn Hodges, USA** (MOVES) is applying this work in his current thesis research, focusing on representation of combat unit data and access to the Unit Order of Battle Data Access Tool (UOB DAT) through Web services. In the MOVES XMSF booth, XMSF partner Dr. Mark Pullen of George Mason University presented the Extensible BML (XBML) work toward a common command and control language for linking M&S systems with C4ISR systems.

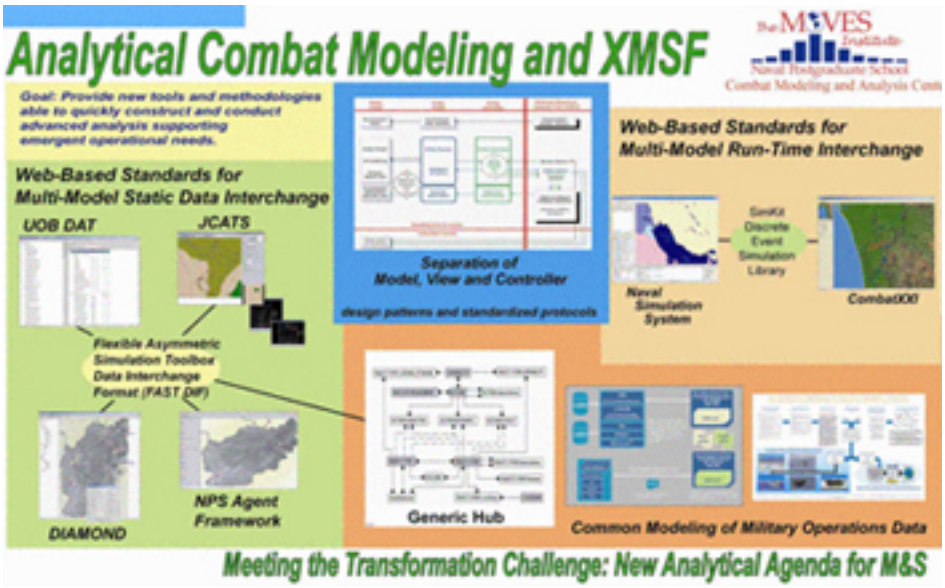

Figure 3. The MOVES Institute is working on DMSO and OPNAV N81 projects to apply XMSF concepts to analytical combat modeling to enable improved data interchange across multiple models and to create a "marketplace" of analytical modeling components from which analysts can configure modeling capabilities required for specific studies.

In addition to these efforts on common vocabularies for data interchange, NPS demonstrated the ability to use the XML expression of scenario data from the FAST models to initialize a multi-agent simulation constructed with the MOVES agent framework by MOVES researchers **John Hiles** and **Randy Jones**. Through an open and common data interchange, arbitrary models can readily tie into the information for specialized studies.

The second application of XMSF concepts to analytical modeling involves researching the development of a transformational analytical modeling framework where Web services and XML-based data interchange are used in an innovative way to connect multiple model components in a flexible, scalable, extensible architecture. Depicted in the upper right of Figure 3, key sources of functionality for these efforts include:

- SimKit discrete event simulation application program interface (API) developed by NPS **Visiting Associate Professor Arnold Buss**,
- Combat XXI under development by the Army and Marine Corps at the Army TRADOC Analysis Center (TRAC), White Sands, which uses SimKit as its core simulation engine,

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ATMOSPHERIC IMPACTS ON 'SEA SHIELD', *continued from page 46*

Associate Professor Qing Wang and her students have been measuring the structure of the turbulent boundary laver with aircraft over the coastal zone and improving the characterization of the boundary flows in high resolution forecast models. Such studies are critical to implementing air-ocean coupled models and providing high resolution forecast wind and thermal structure forecasts for support of military and homeland defense needs.

This is a just a sample of the some of the 54 research projects underway in Department of Meteorology this year. The research provides a framework for challenging thesis projects, supports the continual update of the graduate instructional program for Air Force and Navy curricula, and gives valuable solutions of environmental problems to the warfighter. This mix of basic and applied research, all focused on solutions to military weather problems, is a valuable asset for NPS, DoN and DoD.

MOVES INSTITUTE DEMONSTRATES TECHNOLOGIES FOR MODELING, *continued from page 47*

• Naval Simulation System (NSS) developed by SPAWAR Systems Center, San Diego and managed by NAVAIR.

Following the strategic trajectory of the XMSF effort, this work starts first with functioning exemplars, then progresses to supporting tools, and then steps up to world-class modeling challenges, analysis and results. Shortly after I/ITSEC, NPS received funding from OPNAV N81 to complete the integration of these models and to demonstrate the integrated functionality in a number of FORCEnet-related analyses that require a comprehensive air, land, sea modeling environment. As part of this effort, the MOVES Institute is developing an "analytical workbench" providing a user access to a collection of past and current SimKit models developed in student thesis projects over the past five years. These models will provide a library of analysis tools from which analysts may explore a wide range of problems and from which analysts can evolve customized models to address new problems of interest.

Figure 4. The AT/FP planning tool enables users to visualize and conduct experiments with protection measures against small boat threats against Naval shipping in-port.

Anti-Terrorism / Force Protection (AT/FP) Planning Tool, presented by **LT Scott Rosetti, USN(R)** NPS MOVES Masters student. For his thesis research, **LT James Harney, USN** (Computer Science, Spring 2003) employed the MOVES agent-based simulation constructs and the Xj3D open source implementation of the emerging X3D web-based graphics standard to model small-boat surface threats against ships in port (Figure 4). Inspired by the *USS COLE* bombing in Aden Harbor, the tool allows Force Protection planners to visualize a port in 3D and to run analyses on the placement and capabilities of picket boats for protection against small-boat threats. Aden Harbor, Port Hueneme, and Pearl Harbor are currently available in the tool for visualization and analysis. Recently received tasking from OPNAV N81 will extend the capabilities of the model to examine additional threats and protection measures.

Web-based 3D Visualization of Tactical Databases and Digital Terrain for Operational Planning, presented by **Capt David Lowery, USMC**, NPS Computer Science Masters student and **LCDR Duane Davis, USN**, NPS Computer Science Ph.D. student. Over the past year, a number of students completed XMSF-related research for their thesis projects. **Capt James Neushul, USMC** (Computer Science, Summer 2003) auto-generated XML Schema descriptions of the Digital Terrain Elevation Data (DTED) specification to create XML representations of DTED data files. Once the data is in an XML representation, XSLT is used to transform the terrain elevation data to other forms such as X3D for rendering (Figure 5). CPT Neushul's work provides a basis for rapid generation of 3D terrain for use in simulation and planning systems. **Capt Brian Hittner, USMC** (MOVES, Summer 2003) added terrain-following algorithms to this work so that objects moving over the terrain would have correct orientation. Together, these efforts contributed to Web-based visualization of the 3D battlespace in a July 2003 demonstration for the Joint Forces Command (JFCOM) Distributed Continuous Experimentation Environment (DCEE).

Maj Claude Hutton, USMC (Computer Science, Summer 2003) employed similar open standards Web-based visualization techniques for his thesis work, adding the capability to

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query military databases to dynamically place information icons in the 3D space (terrain elevation data with map overlay). A user "flies" through the 3D environment using a joystick and requests detailed information on objects place in the environment by clicking on the icons. For example, for planning an operation in Iraq, the user can request information on airfields, generate the 3D representation, and fly over the terrain selecting particular airfield icons to obtain additional details (e.g., latitude-longitude location). Information exchanged between the user and the database server, as well as the resulting representation of the battlespace, is all XML-based providing self-validating and self-describing data while simplifying software implementation.

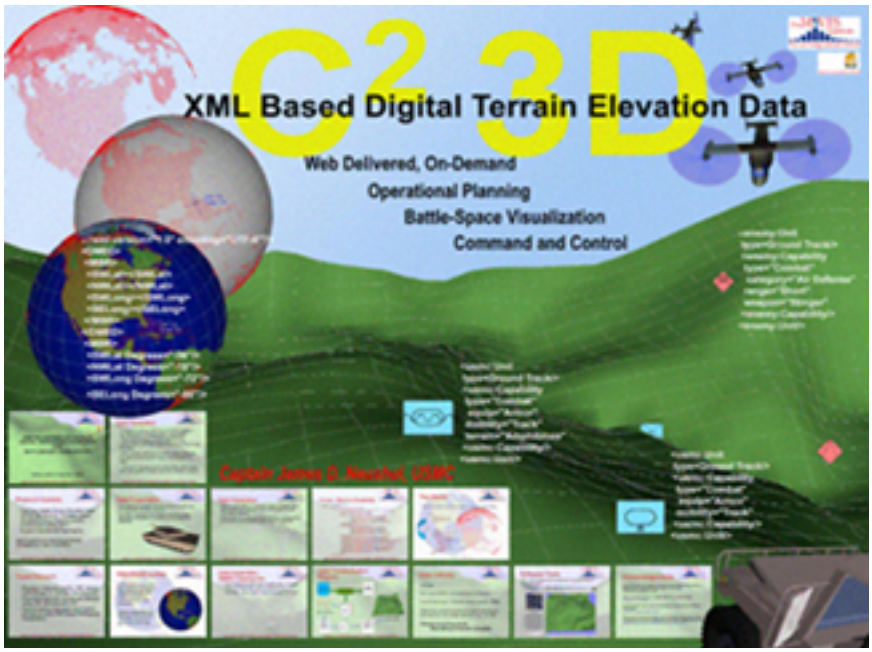

Figure 5. XML-based representations of the operational battlespace provide a basis for creation of virtual environments containing battlespace objects and database content that can be used for mission planning, rehearsal, and analysis.

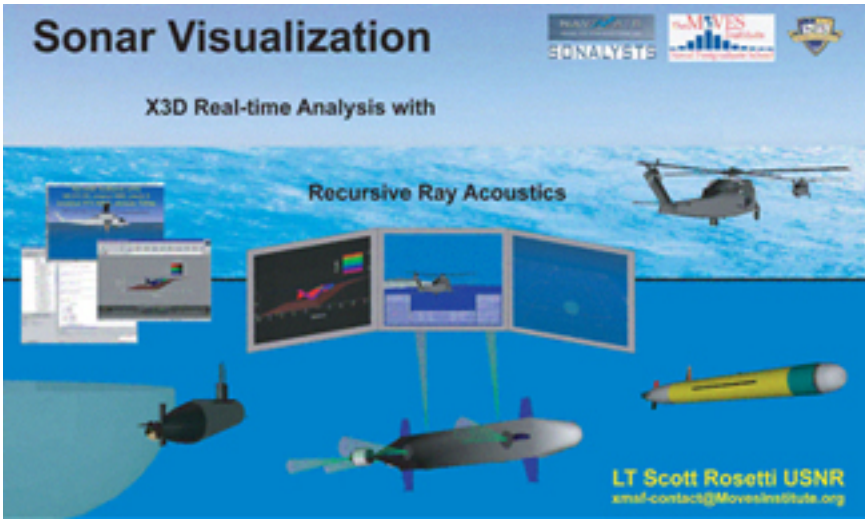

Figure 6. The MOVES Institute is working with Sonalysts, Inc. on sonar propagation physically-based models and visualization techniques to apply to such areas as anti-submarine warfare and Autonomous Underwater Vehicle (AUV) research.

Sonar Visualization for Multi-Platform Net-Centric Undersea Warfare, presented by **LT Scott Rosetti, USN(R)**, with Alan Hudson and Steven Matsuba, Yumetech. The MOVES Institute is conducting research with Sonalysts, Inc. to represent and visualize sonar propagation and performance for use in antisubmarine warfare and Autonomous Underwater Vehicle (AUV) research. In preliminary work, Yumetech implemented recursive ray acoustics algorithms in the Xj3D software environment for visualizations demonstrated at I/ITSEC (see Figure 6). This work is ongoing through a Phase II Small Business Innovative Research (SBIR) award to Sonalysts.

Autonomous Underwater Vehicle (AUV) Workbench, presented by **Chin Siong ("Daryl") Lee**, Singapore, NPS Computer Science Masters student. The MOVES Institute is a major contributor to AUV robotics research at NPS. Student thesis research completed in 2003 defined an XML-based command language for an AUV providing unambiguous and self-validating structure and content of mission plans. The MOVES Institute has developed an AUV Workbench (Figure 7) enabling a user to plan an AUV mission and to visually "execute" the mission to ensure the plan is defined as desired. Mission execution applies physically-based models of the vehicle dynamics for realistic performance of the AUV in the assigned mission

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and ocean environment. Mr. Lee is extending the workbench capabilities in his thesis work in progress.

XML-based Tactical Chat, presented by **Chin Siong ("Daryl") Lee**, Singapore, with **Don McGregor**, MOVES Institute and **LT Dan Devos, USN**, NPS MOVES Masters student. Just as instant messaging and Internet chat have grown considerably over the past few years, the military is finding that this form of communications is rapidly becoming a primary method for coordination in shipboard operations. As a free-form, unstructured interaction, however, much of the analysis value of these communications is lost. The XML-based Tactical Chat (XTC) effort (Figure 8) started as a student project in the Fall 2004 Advanced XML class with the concept that providing structure to the chat interactions through XML representations will provide great operational and analytical benefit to this form of communication. Students in the MOVES Institute, under the technical leadership of Research Professor Don McGregor, have created a tactical chat environment as a basis for ongoing research into this medium. Mr. Lee is working on a current project to apply this technique for software agent intercommunications and LT Dan Devos, USN, is fully describing the XTC concepts in his current thesis work.

Figure 7. The MOVES Institute is working with the NPS Robotics Research Group to create an AUV mission planning environment that uses an XML-based language for AUV mission commands and Web-based 3D visualization for virtual execution of the missions.

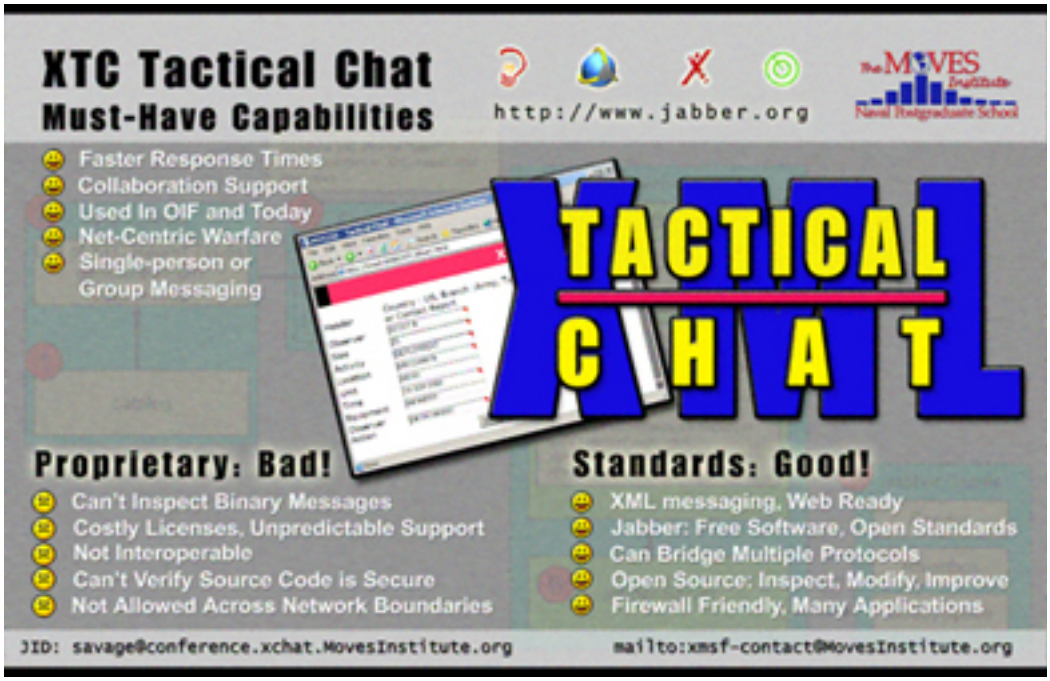

Figure 8. An XML-based Tactical Chat (XTC) environment has been established to support student and faculty research in the architecture and use of this rapidly growing communications technique for military operations and in operational benefits available through application of XML technologies.

NAVAL POSTGRADUATE SCHOOL CHAIR PROFESSORSHIPS

Chair Professorships have been established at the Naval Postgraduate School (NPS) to attract outstanding academicians or practitioners who will contribute significantly to the academic and research programs at NPS. Chair Professors are expected to support NPS curricula and to support Navy/DoD interests.

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