CYBERTERROR
John Arquilla, Associate Professor
Information Warfare and Command, Control, Communications, Computers, and Intelligence Academic Group
Sponors: Defense Intelligence Agency and Joint Special Operations Command

OBJECTIVE: To develop strategy and doctrine for defending against or countering cyberterror.

SUMMARY: This research examines strategic and doctrinal issues across the spectrum, from cyberspace-based electronic attack to more exotic microwave and radio frequency weapons. It also examines the use of cyberspace for what might be called "combat support" functions. One classified thesis examined defensive anti-cyberterror strategies, the other focused on proactive measures that can be taken against cyberterror.

DoD KEY TECHNOLOGY AREAS: Other (Cyberterror)

KEYWORDS: Cyberterror, Cyberspace-Based, Electronic Attack

ANALYTICAL SUPPORT FOR CONVENTIONAL AMMUNITION PROGRAM
Alexander Callahan, Research Assistant Professor
Command, Control, Communications, Computers, and Intelligence Academic Group
Sponsor: Naval Surface Warfare Center-Crane Division

OBJECTIVE: To provide analyst support to the Conventional Ammunition Program Office by implementing NSFS, AAW, and ASW architectures in the Naval Simulation Systems (NSS) and GCAMS. Support will include developing data sources, devising documentation methods, creating input databases, and performing analyses in support of program review.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Modeling and Simulation, Assessment

GUN WEAPONS SYSTEM COMMAND AND CONTROL PROJECT
Alexander Callahan, Research Assistant Professor
Command, Control, Communications, Computers, and Intelligence Academic Group
Sponsor: Naval Surface Warfare Center-Crane Division and Dahlgren Division

OBJECTIVE: Provide gun weapon system analysis of performance and command and control to include consulting, modeling and simulation.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communication

KEYWORDS: Analysis, Modeling and Simulation

NAVAL SIMULATION SYSTEM (NSS) DEVELOPMENT AND TESTING
Alexander Callahan, Research Assistant Professor
Command, Control, Communications, Computers, and Intelligence Academic Group
Sponsor: Commander-in-Chief, Pacific Fleet

OBJECTIVE: Project to provide development of scenario and operational testing of the Naval Simulation System. Scope includes planning, modeling, simulation, and analysis.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Analysis, Modeling, Simulation

DEVELOPMENT OF THE HUMAN-CENTERED DESIGN ASSOCIATE FOR THE MANNING AFFORDABILITY PROJECT

Susan G. Hutchins, Research Assistant Professor
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Sponsor: Naval Air Warfare Center–Training Systems Division

OBJECTIVE: The overall purpose of this effort is to support the development of the "Human-Centered Design Associate" (HCDA), an intelligent software agent designed to provide human factors knowledge and expertise to a system designer. In particular, there are three tasks. The first task is to provide human factors guidelines to populate the database of the intelligent search agent component of the HCDA. The second task is to provide guidance in the search for additional high payoff areas within the system design process that can be supported with HCDA components. The third task is to support the testing and evaluation of each component of the HCDA. This work is part of a continuing project.

The focus for this year's effort was on an analysis of design problems found in complex military command and control systems and the ways in which these types of problems can be avoided in future system design. The source of data for this analysis was a group of case studies of forty-two U.S. military systems written by officer-students at the Naval Postgraduate School, Monterey, CA. Systems analyzed span the four military services and include aircraft systems, communications systems, the M-16 rifle, a missile defense system, and a message processing system, weapon systems, and decision support systems. Case studies of military command and control systems contain examples of the ways in which inadequate emphasis on human considerations can negatively impact overall system performance. These case studies were analyzed to provide concrete examples of the types of design problems found and where in the systems engineering process these problems could have been avoided had proper emphasis been given to human factors issues. Documented problems with system use were categorized according to the following measures of effectiveness: Performance, Safety, Usability, Reliability, Maintain-ability, Time and Cost to Train, and Workload.

SUMMARY: Support provided to accomplish project goals included the following: (1) obtaining a set of guidelines on situation awareness to be added to the database, (2) reviewing existing guidelines in the HCDA database to determine where linkages should be established to other parts of the database, i.e., where material found under one topic in the database would also be appropriate under another topic area of the database, and (3) conducting an analysis of case studies of complex military systems to determine what types of system use problems were encountered and how these problems could have been avoided had the appropriate testing been accomplished during system design.

PUBLICATIONS:

Hutchins, S.G., "Application of Naturalistic Decision Making Models to Support Command and Control Decision Making," *Proceedings of Workshop on Modeling for Command*, Royal Military College of Canada, Kingston, Ontario, Canada, 21-22 March 2000.

Hutchins, S.G. and Marvel, O.E., "Analysis of Human Factors Case Studies of Complex Military Systems: Implications for System Design," *Proceedings of the 5th International Conference on Human Interaction With Complex Systems*, 30 April–2 May 2000, Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, IL, pp. 153–157.

Hutchins, S.G., "Analysis of Human Factors Case Studies of Complex Military Systems: Surely We Can Do Better," *Proceedings of the International Society of Optical Engineering*, San Diego, CA, 30 July–4 August 2000.

Hutchins, S.G., *Case Studies of Complex Military Systems to Illustrate Examples of Poor System Design*, Naval Postgraduate School Technical Report.

PRESENTATIONS:

Hutchins, S.G., "Application of Naturalistic Decision Making Models to Support Command and Control Decision Making," presented to the Royal Military College of Canada, Workshop on Modeling for Command, Kingston, Ontario, Canada, 21-22 March 2000.

Hutchins, S.G., Hocevar, S.P., and Kemple, W.G., "Comparison of High and Low Task Performance Via Assessment of Team Communications in a Joint Command and Control Environment," presented to the Society of Industrial and Organizational Psychologists, 14-16 April 2000, New Orleans, LA.

Hutchins, S.G. and Marvel, O.E., "Analysis of Human Factors Case Studies of Complex Military Systems: Implications for System Design," presented to the 5th International Conference on Human Interaction with Complex Systems 2000, Beckman Institute for Advanced Science and Technology, University of Illinois, IL, 30 April-2 May 2000.

Hutchins, S.G., "Human Factors Analysis of Complex Military Systems: Surely We Can Do Better," Paper presented to the International Society of Optical Engineering, San Diego, CA, 30 July-4 August 2000.

DoD KEY TECNOLOGY AREAS: Human Systems Interface

KEYWORDS: Human Factors, Automation, Decision Theory, Command and Control, Decision Support System, Human Systems Interface

RED CELL ANALYSIS OF DISRUPTIVE TECHNOLOGIES IDENTIFICATION OF POTENTIAL ADVERSARY SYSTEMS AND TECHNOLOGIES TO DISRUPT U.S. NAVAL OPERATIONS

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D. C. Schleher, Professor
Information Warfare Academic Group
Robert C. Harney, Senior Lecturer
Department of Physics
Sponsor: Naval Warfare Development Command

OBJECTIVE: Assess disruptive technologies that might be employed in the 2015 time frame to deny access to the U.S. Navy. Compare the list of disruptive technologies to and reconcile with U.S. intelligence agencies' assessments.

SUMMARY: This study was directed at identifying and analyzing commercial-off-the-shelf and readily available technologies that might be available to a U.S. adversary in the 2007 to 2015 time frame to use in a disruptive manner in an anti-access role against U.S. Naval forces. Five dimensions of battle space were considered: Surface (land and sea), subsurface (land and sea), air, space and cyberspace. Estimates were made of the probability of employment of each of the systems and technologies based on maturity of the systems and technologies, probable costs and development schedules and any other relevant factors. Previous Naval Postgraduate School student area denial study results, published lists of critical technologies, and brainstorming by Naval Postgraduate faculty and systems engineering integration (SEI) students were used as inputs to this study. The approach taken was to encourage "thinking out of the box" rather than relying on observed evidences of potential threats. Systems and technologies were evaluated in terms of their impact on U.S. forces in an anti-access mode and their probability of occurring. Systems ranked high in both impact and probability of occurrence were analyzed further, where appropriate, to determine estimates of system parameters. Twenty-four systems, technologies and attack mechanisms

were determined to be high risk to U.S. naval forces. Sixteen systems, technologies and attack mechanisms were found to be medium risk.

PUBLICATION:

Osmundson, J.S., "ANTI-ACCESS SYSTEMS STUDY, Identification of Potential Adversary Systems and Technologies to Disrupt US Naval Operations," Naval Postgraduate School Technical Report, NPS-IJWA-01-015, 31 January 2001.

COMBAT IDENTIFICATION TRADE STUDIES

John S. Osmundson, Associate Professor
Command, Control, Communications, Computers, and Intelligence Academic Group
Sponsor: U.S. Marine Corps Systems Command

OBJECTIVE: Conduct trade studies to 1) determine whether a battlefield wireless communication system designed for command and control can also carry CID information, 2) determine fundamental CID requirements for a variety of USMC scenarios, and 3) determine requirements for joint CID interoperability.

SUMMARY: Three studies were performed at the Naval Postgraduate School under sponsorship of the U.S. Marine Corp Systems Command that address USMC combat identification (CID) issues from a systems and systems engineering perspective. In the first study USMC CID requirements for a range of combat conditions were determined and compared by analyzing computer simulations of several combat scenarios including military operations in urban terrain (MOUT.) In the second study wireless local area networks (WaveLANs) used for recent Extended Land Battlefield (ELB) advanced concept technology demonstrations were scaled, then modeled and simulated to determine their suitability to transmit CID information. Results showed that WaveLANs have the capacity to handle all expected CID information of a large-scale joint battle force, as well as meet USMC CID and other command and control needs. In the third study the interoperability of USMC CID systems with other service and coalition force CID systems was addressed. Conclusions of this study showed that there are major CID interoperability problems and that the Department of Defense is not properly organized to solve these problems.

PUBLICATIONS:

Osmundson, J.S., Arp, L.T., Parker, M.A., Stewart, K.J., and Kemple, W.G., "Scaling Analysis of Wireless Local Area Network Technology to large Scale Battlefields," accepted for publication in *Military Operations Research*, 2001.

Osmundson, J.S., Allegretti, B., Schlafer, C., and Stewart, K., "Systems Studies of U.S. Marine Corps Combat Identification Issues," *CISC 2000 Proceedings*, 12-14 September 2000, Norfolk, VA.

THESES DIRECTED:

Allegretti, B., "Situational Awareness Data Requirements for a Combat Identification Network," Masters Thesis, Naval Postgraduate School, September 2000.

Schlafer, C., "Joint Interoperability Considerations for Combat Identification (CID) Systems in Air-to-Ground Mission Area," Masters Thesis, Naval Postgraduate School, September 2000.

Stewart, K., "Impact of Including Realistic Combat Identification (CID) Requirements on a Large Scale Information System Architecture Versus the Use of a Separate CID Information System Network," Masters Thesis, Naval Postgraduate School, September 2000.

INVESTIGATION OF THE UTILITY OF SPACE RECONNAISSANCE AS AN AID TO COMBAT IDENTIFICATION

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Command, Control, Communications, Computers, and Intelligence Academic Group
Sponsor: National Reconnaissance Office

OBJECTIVE: The objective of this study was to analyze the utility of space-based reconnaissance to the problem of combat identification (CID) in a joint warfighting environment. In particular the utility of space reconnaissance as a cueing system for organic battlefield combat identification (CID) systems and/or as a system to provide CID information to battlefield users was to be determined.

SUMMARY: CID scenarios were developed and analyzed for joint force operations. Analysis of scenarios indicated that a sensor system that provides positive hostile IDs over a wide battlefield would have high combat utility and that overhead sensor data is compatible with an organic information system.

The problem from a space system point of view is the requirement for real time or very near real time target recognition, implying a high level of on-board processing and the capability to directly link to a battlefield communications node at high data rates. Also, the need to use low earth orbit platforms in order to meet a 0.3 m imaging requirement combined with the lack of predictable and continuous availability of target signatures makes the use of space-based imaging systems for direct support of battlefield CID problematic.

Future CID systems may utilize unmanned air vehicles (UAVs) as an adjunct to organic GPS based organic sensor systems. A space-based system could be valuable in obtaining cueing indicators in areas behind immediate combat areas and providing cueing information to UAVs that in turn would provide positive hostile IDs to an organic CID information system. Processing and dissemination timeline requirements for a space-based cueing system would be relaxed to about 30 minutes when operating in this mode as compared to ~ 15 seconds when operating as a direct adjunct system. Also, the requirement to image to 0.3 m resolution would be relaxed as well as introducing the possibility of collecting other signature data in place of imagery.

OTHER:

Osmundson, J.J., "Investigation of the Utility of Space Reconnaissance as an Aid to Combat Identification," Report to the NRO, 10 December 1999.

ANTI-ACCESS SYSTEMS STUDY

John S. Osmundson, Associate Professor
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D. C. Schleher, Professor
Department of Electrical and Computer Engineering and Information Warfare Academic Group
Robert C. Harney, Senior Lecturer
Department of Physics
Sponsor: Naval Warfare Development Command

OBJECTIVE: To determine systems and technologies that may pose disruptive threats to U. S. Naval forces when the systems and technologies are used in a mode whose function is to deny U. S. forces access to land and ocean areas.

SUMMARY: A large number of technologies and systems were examined for their potential to provide a disruptive influence on the capability of U. S. Navy forces to exert sea and area control and power projection in the Littoral region. Systems were ranked relative to their impact and likelihood of occurrence while risk was determined as the product of these factors. Twenty-four systems ranked high in both impact and likelihood, sixteen systems exhibited medium risk while seventeen systems were ranked as low risk. Technology and disruptive systems were generally categorized into delivery systems, logistics, attack mechanisms, counter measures, sensors, weapon types and cyber warfare. In addition, sixteen disruptive

systems are described in detail. These include High Energy Laser Weapons, Naval Glide Bombs, GPS Jamming, Microwave Weapons, Mini and Micro Air Vehicles, and Unmanned Combat Air Vehicles.

DoD KEY TECHNOLOGY AREAS: Other (Disruptive Technologies)

KEYWORDS: Area Access Denial, Disruptive Technology, Threats