DEPARTMENT OF APPLIED MATHEMATICS

MICHAEL S. MORGAN
CHAIRMAN

APPLIED MATHEMATICS

OVERVIEW:

The Naval Postgraduate School (NPS) Applied Mathematics Department is committed to excellence. Our purpose is to provide an exceptional mathematical education focused on the unique needs of our students, to produce relevant research for our sponsors, and to provide quality service to the community. We further are committed to maintenance of a well-designed curriculum and a supportive environment for our students.

CURRICULA SUPPORTED:

- The majority of the departmental effort is devoted to the service courses offered which support a variety of curricula.

DEGREES GRANTED:

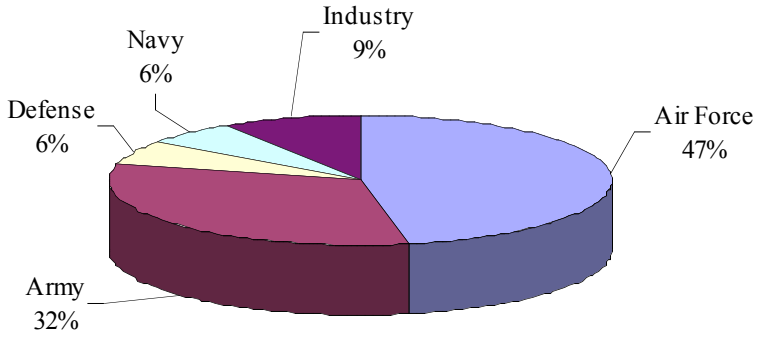
- Master of Science in Applied Mathematics
- Doctor of Philosophy

RESEARCH THRUSTS:

- Scientific Computation
- Control Theory
- Approximation
- Numerical Modeling

RESEARCH PROGRAM (Research and Academic)-FY2004:

The Naval Postgraduate School's sponsored program exceeded $92 million in FY2004. Sponsored programs include both research and educational activities funded from an external source. A profile of the sponsored program for the Department of Applied Mathematics is provided below.



Size of Program: $475K

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BRIEF INVESTIGATION OF CONFIGURAL MINE WARFARE THEORY

Carlos F. Borges, Associate Professor
Department of Applied Mathematics
Sponsor: Naval Postgraduate School

OBJECTIVES: To perform a brief preliminary investigation of the configural theory of mine warfare with an eye toward developing some basic tools using the theory.

SUMMARY: This effort looked at the configural theory of mine warfare. A significant part of the effort was collecting and reading much of the work to date in configural mine warfare. At the end of that time, a summary report was written giving a carefully documented analytical solution to a simple, but essential, mine warfare scenario. It was shown that a wide variety of analysis is possible and that these yield a variety of insights into the problem. A proposal for more in depth follow-on work was submitted.

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

KEYWORDS: Mine Warfare, Configural

TOTAL LEAST SQUARES FITTING OF ORDERED DATA WITH POLYNOMIAL SPLINES

Carlos F. Borges, Associate Professor
Department of Applied Mathematics
Sponsor: Unfunded

OBJECTIVES: To develop fast and numerically stable algorithms for fitting polynomial splines to ordered data with minimal error in the total least-squares sense.

SUMMARY: This unfunded effort was a continuing research project. The idea was to fit parametric polynomial spline curves to ordered data to get the best possible fit. Unlike traditional least-squares methods, it was assumed that errors may occur in both the x and y directions. Moreover, the data was allowed to be completely general - in particular, it did not have to be functional in nature, and it could overlap itself or change directions without restriction. All that was required was an ordered set of points in the plane. This year, the focus was on rapid algorithms for computing the QR decomposition of a generalization of the Vandermonde matrix. Results were mixed - better speed but a loss of accuracy. More research is needed.

DoD KEY TECHNOLOGY AREA: Scientific Computation

KEYWORDS: Curve Fitting, Data Compression, and Approximation Theory

BUCKLING OF SHIP GRILLAGES WITH BULB FLAT STIFFENERS

Donald A. Danielson, Professor
Department of Applied Mathematics
Sponsor: Naval Surface Warfare Center – Carderock Division

OBJECTIVES: To use analytical formulas and finite element models to calculate the buckling loads of ship grillages with bulb flat stiffeners.

SUMMARY: A series of multi-bay steel grillages typical of ship structures were tested to collapse at the Naval Surface Warfare Center. Some of the grillages were made of plate panels strengthened longitudinally with bulb flat stiffeners. In this report a theory was developed to predict the failure stresses of bulb flat grillages. It was postulated that a grillage buckles initially into either a tripping or a column mode. Formulas were provided for the critical buckling stresses associated with these modes. The theory was compared to the experiments and found to give usually conservative predictions.

PUBLICATION:

Danielson, D.A., Wilmer, A., "Buckling of Stiffened Plates with Bulb Flat Flanges," *International Journal of Solids and Structures*, Vol. 41, pp. 6407-6427, 2004.

TECHNICAL REPORT:

Danielson, D.A., "Failure of Stiffened Plates with Bulb Flat Flanges," Naval Postgraduate School Technical Report, NPS-MA-04-002, September 2004.

KEYWORDS: Structure, Ship, Grillage, Stiffener, Buckling

ADVANCED RADAR DIGITAL SIGNAL PROCESSING USING COMMERCIAL-OFF-THE-SHELF (COTS) COMPUTERS WITH RECONFIGURABLE ARCHITECTURES

Douglas J. Fouts, Professor
Department of Electrical and Computer Engineering
David R. Canright, Associate Professor
Department of Applied Mathematics
Sponsor: National Security Agency

OBJECTIVES: To design, construct, debug, and test a hardware and software interface between a radar and a commercial-off-the-shelf (COTS) computer with a reconfigurable architecture in order to perform advanced digital signal processing of radar signals using the reconfigurable computer. A second objective is to develop a fully pipelined version of the Advanced Encryption Algorithm (AES) for the same COTS computer with a reconfigurable architecture.

See the FAR of Professor Douglas Fouts (Department of Electrical and Computer Engineering) for the Project Summary relating to the first objective; the summary below relates to the second objective.

SUMMARY: The specific reconfigurable computer chosen for this work is an SRC-6E from SRC Computer Corp. The reconfigurable part of this system uses Virtex II field-programmable gate arrays (FPGA). Constraints in this system precluded a fully pipelined implementation of AES using a table lookup approach for the crucial S-Box step. Instead, another approach to the S-Box was developed, replacing the table with a direct calculation using a compact arrangement of logic gates. Mathematically, this involves using subfields for the Galois arithmetic, and different alternatives in each subfield result in 432 different implementations of this method. From these, the most compact was identified and optimized, yielding an S-Box circuit 20% smaller than the most compact previously known. This allowed a fully pipelined AES on a single Virtex II chip; the same approach may be useful for other hardware-limited implementations of AES, e.g., smart cards.

PRESENTATIONS:

Fouts, D., Macklin, K., and Zulaica, D., "Electronic Warfare DSP Applications Using Reconfigurable Computers," 2004 Military Applications of Programmable Logic Devices Conference, Washington, D.C., September 2004.

Fouts, D.J., Macklin, K., Zulaica, D., and Duren, R., "Electronic Warfare DSP Applications Using Reconfigurable Computers," Classified Technology Update Course, Naval Postgraduate School, July 2004.

TECHNICAL REPORT:

Canright, D., "A Very Compact Rijndael S-box," Naval Postgraduate School Technical Report, NPS-MA-04-001, December 2004.

THESES DIRECTED:

Macklin, K.R., "Benchmarking and Analysis of the SRC-6E Reconfigurable Computing System," Master's Thesis, Naval Postgraduate School, March 2004.

Macklin, K.R., "Suitability of the SRC-6E Reconfigurable Computing System for Generating False Radar Images," Master's Thesis, Naval Postgraduate School, June 2004.

KEYWORDS: Reconfigurable Computing, Cryptography, AES, Rijndael

COMPUTATIONAL MATHEMATICS PROGRAM

Fariba Fahroo, Associate Professor
Department of Applied Mathematics
Sponsor: Air Force Office of Scientific Research

OBJECTIVES: To manage the computational math program at the Air Force Office of Scientific Research in Arlington, Virginia.

SUMMARY: This program manages a multi-million dollar basic research effort at the university and Air Force Labs level to develop improved numerical and mathematical modeling and simulation capabilities for Air Force needs.

The program also supports the national Air Force program in high performance computing. Duties involve managing the portfolio by knowing the latest trends in computational algorithm developments (as related to the Air Force), visiting the Principal Investigators, holding program review meetings, maintaining inter-agency and inter-service contacts with other Department of Defense (DoD) funding agencies and increasing the portfolio's exposure internally and externally to attract more funding for more research programs.

KEYWORDS: Computational Mathematics, Numerical Modeling, Mathematical Modeling

DEVELOPMENT OF ON-LINE FOOTPRINT GENERATION ALGORITHMS FOR SPACE ACCESS VEHICLES WITH CONTROL FAILURES

Fariba Fahroo, Associate Professor
Department of Applied Mathematics
Sponsor: Unfunded

OBJECTIVES: To develop fast and accurate numerical methods for determining the largest reachable set (footprint) for a reusable launch vehicle under actuator failure.

SUMMARY: This research project was the continuation of the work done at the Air Force Research Laboratory (AFRL) in 2002. The ultimate goals of this research were to develop advanced guidance and control algorithms for hypersonic and reusable launch vehicles. One application is in the area of determining reachable regions by a reentry or un-powered hypersonic vehicle experiencing control effector failures. This problem was formulated as a parameter dependent optimal control problem and was solved using a numerical package developed at the Naval Postgraduate School (NPS) by (Mike Ross and the Principal Investigator). Future goals of the project will involve designing an adaptive reconfigurable control system for the X-40A vehicle to support a flight-test demonstration of an integrated adaptive guidance and control system.

PUBLICATION:

Fahroo, F. and Doman, D., "A Direct Method for Approach and Landing Trajectory Reshaping with Failure Effect Estimation," *Proceedings of the American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation and Control Conference,* Providence, RI, August 2004.

PRESENTATION:

Fahroo, F. and Doman, D., "A Direct Method for Approach and Landing Trajectory Reshaping with Failure Effect Estimation,'' 2004 AIAA Conference on Guidance, Navigation and Control, Providence, RI, August 2004.

DoD KEY TECHNOLOGY AREA: Space Vehicles

KEYWORDS: Trajectory Optimization, Guidance, Footprint Generation, Reusable Launch Vehicles, Pseudospectral Methods

NATURAL ADAPTIVE OBSERVERS FOR 2ND –O DISTRIBUTED PARAMETER SYSTEMS

Fariba Fahroo, Associate Professor
Department of Applied Mathematics
Sponsor: Unfunded

SUMMARY: Collaboration with Professor Michael Demetriou at Worcester Polytechnic Institute.

CONFERENCE PUBLICATIONS:

Demetriou, M. and Fahroo, F., "A Natural Observer-Based Adaptive Controller for Structurally Perturbed Second Order Distributed Parameter Systems," *Proceedings of the Mathematical Theory of Networks and Systems (MTNS) Conference*, Leuven, Belgium, July 2004.

Demetriou, M., and Fahroo, F., "An Adaptive Control Scheme for a Class of Second Order Distributed Parameter Systems with Structured Perturbations," *Proceedings of the IEEE Conference on Decision and Control,* Bahamas, December 2004.

KEYWORDS: Worcester Polytechic Institute, –O Distributed Parameter Systems

REAL-TIME COMPUTATION OF TRAJECTORIES FOR HYPERSONIC LAUNCH VEHICLES

Fariba Fahroo, Associate Professor
Department of Applied Mathematics
Sponsor: Unfunded

OBJECTIVES: To develop numerical algorithms for computing trajectories for re-entry launch vehicle in real-time, and to study the numerical properties, such as convergence and stability, of these algorithms.

SUMMARY: In this project, computational methods for generating optimal trajectories for re-entry vehicles subject to three DOF nonlinear dynamics were considered. Mathematically the problem was formulated within the framework of nonlinear and possibly non-smooth optimal control theory. Issues such as numerical stability and convergence of a class of numerical methods, pseudospectral methods, were considered. In addition real-time implementation of the methods was also studied.

PUBLICATIONS:

Ross, I.M. and Fahroo, F., "Issues in the Real-Time Computation of Optimal Control," *Journal of Mathematical and Computer Modeling,* Pergaman Press, November 2004, (accepted).

Ross, I.M. and Fahroo, F., "Pseudospectral Knotting Methods for Solving Optimal Control Problems," *Journal of Guidance, Control and Dynamics,* Vol. 27, No. 3, pp. 397-405, 2004.

CONFERENCE PUBLICATIONS:

Ross, I.M. and Fahroo, F., "Discrete Verification of Necessary Conditions for Switched Nonlinear Optimal Control Systems," *Proceedings of the American Control Conference,* Boston, MA, June 2004.

Ross, I.M. and Fahroo, F., "Pseudospectral Methods for Optimal Motion Planning of Differentially Flat Systems," *IEEE Transactions on Automatic Control,* Vol. 49, No. 8, pp. 1410-1413, 2004.

DoD KEY TECHNOLOGY AREA: Space Vehicles

KEYWORDS: Trajectory Optimization, Guidance, Pseudospectral Methods

PHYSICAL DERIVATION OF LANGMUIR-CHILD SPACE CHARGE LIMITED EMISSION

Christopher L. Frenzen, Associate Professor
Department of Applied Mathematics
Sponsor: Unfunded

OBJECTIVES: To develop a simple capacitive model for Langmuir Child space charge limited emission using vacuum capacitance, conservation of energy, and conservation of charge.

SUMMARY: The fundamental Child–Langmuir limit on the maximum current density in a vacuum between two infinite parallel electrodes is one of the most well-known and often applied rules of plasma physics. Researchers developed a simple model using vacuum capacitance, conservation of energy, conservation of charge to derive the Child–Langmuir space-charge-limited emission. This capacitive model provided physical insight into the origins of the well known (voltage) ^3/2/ (gap distance) ^2 scaling of the classical current density and did not require the solution of the nonlinear differential equation normally associated with the Child–Langmuir formulation. In addition, the full space charge- limited solution was reproduced without imposing the condition that the electric field be driven to zero at the cathode surface.

THESIS DIRECTED:

Carr, C.G., "Space Charge Limited Emission Studies Using Coulomb's Law," Master's Thesis, Naval Postgraduate School, June 2004.

KEYWORDS: Langmuir Child, Space Charge Limited Emission, Vacuum Capacitance

COOPERATIVE CONTROL OF MULTI-STEP MANUFACTURING SYSTEMS

Wei Kang, Associate Professor
Department of Applied Mathematics
Sponsor: Intel Corp

OBJECTIVES: To develop software for implementation of the adaptive run-to-run control method developed during the first year of the project; to push the research to a larger scale for multiple step processes; to develop control architecture and feedback algorithms to achieve cooperative control of the semiconductor manufacturing process with multiple processing steps.

SUMMARY: Working with engineers from Intel, the variables and steps that are critical to the overall performance of the multi-step manufacturing process were successfully identified. Based on real manufacturing data, a three-layer cooperative control architecture was developed. A mathematical model was developed for each layer of the process based on real data and important multiple input and output parameters. Cooperative control law was under development to optimize the cost functions under the constraints and based on real-time information. Meanwhile, simulations based on real data were carried out for lower layer subsystem control.

PUBLICATIONS:

Hamzi, B., Kang, W., and Barbot, J.-P., "Analysis and Control of Hopf Bifurcations," *SIAM Journal on Control and Optimization*, Vol. 42, No. 6, pp. 2200-2220, 2004.

Hamzi, B., Kang, W., and Krener, A.J., "The Controlled Center Dynamics," *SIAM Journal of Multiscale Modeling and Simulation*, (to appear).

Kang, W., Song, M., and Xi, N., "Bifurcation Control, Manufacturing Planning, and Formation Control," *Automatica Sinica*, 2005, (to appear).

Kang, W., Xi, N., Tan, J., and Wang, Y., "Formation Control of Multiple Autonomous Robots: Theory and Experimentation," *Intelligent Automation and Soft Computing*, Vol. 10, No. 2, pp. 1-17, 2004.

Kang, W., Xi, N., Tan, J., Zhao, Y., and Wang, Y., "Coordinated Formation Control of Multiple Nonlinear Systems," *Journal of Control Theory and Applications*, (to appear).

Krener, A.J., Kang, W., and Chang, D., "Control Bifurcations," *IEEE Transactions on Automatic Control*, Vol. 49, pp. 1231-1246, 2004.

CONFERENCE PUBLICATIONS:

Gong, Q., Ross, I.M., Kang, W., and Fahroo, F., "Convergence of Pseudospectral Methods for Constrained Nonlinear Optimal Control Problems," *IASTED International Conference on Intelligent Systems and Control*, pp. 209-214, Honolulu, HI, August 2004.

Hamzi, B., Kang, W., and Krener, A.J., "The Controlled Center Dynamics of Discrete Time Control Bifurcations," *Nonlinear Control Systems 2004 (NOLCOS04)*, Stuttgart, Germany, September 2004.

Hamzi, B., Kang, W., and Krener, A.J., "Stabilization of Discrete Time Systems with a Fold or Period-Doubling Control Bifurcation," *IFAC World Congress*, Praha, Spain, 2005, (to appear).

Kang, W. and Mao, J., "An Adaptive Model for the Control of Critical Dimension in Photolithography Process," *Proceedings of the IEEE Conference on Decision and Control*, December 2004.

Kang, W. and Mao, J., "Adaptive Modeling and H_∞ Control for Photolithography Manufacturing Process," *Proceedings of the American Control Conference*, Boston, MA, June 2004.

Kang, W. and Mao, J., "Robust Control of Lithographic Process in Semiconductor Manufacturing," *Proceedings of the SPIE Symposium on Microlithography*, March 2005.

PRESENTATION:

Kang, W., "CD Control with Adaptive Modeling and Robust Feedback," High Volume Manufacturing Research Committee, Intel Corporation, October 2004, (invited).

KEYWORDS: Multistep Manufacturing, Run-to-Run Control, Intel

TEMASEK SUPPORT
Bard K. Mansager, Senior Lecturer
Department of Applied Mathematics
Sponsor: Naval Postgraduate School

DEVELOPMENT OF JOINT CAMPAIGN FEDERATION OF MODELS FOR WEAPONS OF MASS DESTRUCTION

Beny Neta, Professor
Department of Applied Mathematics
Sponsor: Defense Threat Reduction Agency

SUMMARY: Used knowledge of existing and future combat and other constructive simulations and mathematical models to investigate how to play the effects of weapons of mass destruction (WMD) in a campaign context. Investigated the feasibility of employing a federation of computer-based models.

KEYWORDS: Semiconductor Manufacturing, WMD

A STUDY OF LATERAL BOUNDARY CONDITIONS FOR THE NAVAL RESEARCH LABORATORY'S (NRL) COUPLED OCEAN/ATMOSPHERE MESOSCALE PREDICTION SYSTEM (COAMPS)

Beny Neta, Professor
Department of Applied Mathematics
Sponsor: Naval Postgraduate School

OBJECTIVES: The treatment of lateral boundaries in regional models has been a perennial problem since the early days of numerical weather prediction. In a limited-area model the lateral edges are not physical boundaries of the flow but constitute artificial constraints imposed by computational considerations. Hence, they do not have a physical counterpart. Conditions must be imposed at these artificial boundaries in order to solve the problem in an efficient and accurate manner.

The goal of this research was to continue work on high order non-reflecting boundary conditions for the dispersive Klein-Gordon equation. Researchers intend to extend the new schemes to the nonlinear shallow water equations.

PUBLICATIONS:

Givoli, D., Neta, B., and van Joolen, V., "Application of Higdon Non-Reflecting Boundary Conditions to Shallow Water Models," *Proceedings of the International Conference on Spectral and High Order Methods, 2004 (ICOSAHOM 2004),* T. Hagstrom and T. Warburton (Eds.), Brown University, Providence, RI, 21-25 June 2004.

Navon, I.M., Neta, B., and Hussaini, M.Y., "A Perfectly Matched Layer Approach to the Linearized Shallow Water Equations Models," *Monthly Weather Review*, 132, No. 6, 1369-1378, 2004.

Taylor, J.G., Neta, B., and Shugart, P.A., "An Analytical Model that Provides Insights into Various C2 Issues," *Proceedings of the 2004 Command and Control Research and Technology Symposium.*

van Joolen, V., Neta, B., and Givoli, D., "High-Order Boundary Conditions for Linearized Shallow Water Equations with Stratification, Dispersion and Advection," *International Journal Numerical Methods in Fluids*, 46(4), 361-381, 2004.

van Joolen, V., Neta, B., and Givoli, D., "High-Order Higdon-Like Boundary Conditions for Exterior Transient Wave Problems," *International Journal Numerical Methods in Engineering*, (accepted).

van Joolen, V., Neta, B., and Givoli, D., "A Stratified Dispersive Wave Model with High-Order Non-Reflecting Boundary Conditions," *Computers and Mathematics with Applications*, 48, 1167-1180, 2004.

PRESENTATIONS:

Givoli, D., Neta, B., and van Joolen, V., "Application of Higdon Non-Reflecting Boundary Conditions to Shallow Water Models," International Conference on Spectral and High Order Methods, 2004 (ICOSAHOM 2004), Brown University, Providence, RI, 21-25 June 2004.

Taylor, J.G., Neta, B., and Shugart, P.A., "An Analytical Model that Provides Insights into Various C2 Issues," 2004 Command and Control Research and Technology Symposium.

THESIS DIRECTED:

Harris, B.G., "Analysis of Lateral Boundary Effects on Inner Domain of COAMPS," Master's Thesis, Naval Postgraduate School, September 2004.

DOD KEY TECHNOLOGY AREA: Software

KEYWORDS: Mesoscale, Limited-Area Model, Perfectly Matched Layers, COAMPS

MATHEMATICAL MODELS OF SEARCH

Guillermo Owen, Distinguished Professor
Department of Applied Mathematics
Sponsor: Naval Postgraduate School

SUMMARY: This project was funded through the Department of Defense Analysis (DA). Professor Owen and Professor Gordon McCormick of DA are co-principal investigators. Professors McCormick and Owen have developed game-theoretic models for search; on this topic, one article was submitted for publication.

PUBLICATION:

Owen, G. and McCormick, G., "Manhunting," submitted to a volume of articles in honor of Martin Shubik.

KEYWORDS: Mathematical Models, Game Theory

MATHEMATICAL MODELS OF TERRORISM AND LOW-INTENSITY CONFLICT

Guillermo Owen, Distinguished Professor
Department of Applied Mathematics
Sponsor: Naval Postgraduate School

SUMMARY: Professors McCormick and Owen have developed game-theoretic models for the problem of counter-proliferation; on this topic, one article was submitted for publication. They also developed models of low-intensity conflict, and particularly, civil war. One article was submitted and accepted for publication. They are currently studying the problem of state sponsors of terrorism. An article is in preparation.

PUBLICATIONS:

McCormick, G. and Owen, G., "A Mathematical Model of Counter-Proliferation, with Multiple Entrants," *International Game Theory Review*, 2005, (invited).

Owen, G. and McCormick, G., "Factionalism, Violence, and Bargaining in Civil Wars," *Homo Economicus*, 361-390, 2004.

PRESENTATION:

McCormick, G. and Owen, G., "A Mathematical Model of Counter-Proliferation, with Multiple Entrants," Free University of Amsterdam, 29 June 2004.

KEYWORDS: Game Theory, Counter Proliferation, Civil War

RESEARCH PROJECT SUMMARY THEORY OF GAMES AND APPLICATIONS
Guillermo Owen, Distinguished Professor
Department of Applied Mathematics
Sponsor: Unfunded

OBJECTIVES: This was an unsponsored project, on which Professor Owen has worked with mathematicians at the Complutense University in Madrid, Spain, and at the University of Hamburg, Germany. He published an article dealing with centrality in social networks, and submitted a second one for publication. He also submitted an article on reduced games and consistent values, which was accepted for publication.

KEYWORDS: Game Theory, Complutense University, University of Hamburg, Social Networks

MODELING TARGET ACQUISITION, TRACKING, AND LOSS IN MILITARY OPERATIONS IN URBAN TERRAIN (MOUT) USING GRAPHS
Craig Rasmussen, Associate Professor
Department of Applied Mathematics
Sponsor: TRADOC Analysis Center - Monterey

OBJECTIVES: To model target acquisition, tracking and loss in Military Operations in Urban Terrain (MOUT) with graphs, and to then apply analysis techniques such as those from the theory of random graphs to gain insights for the Objective Force (OF) and Future Combat System (FCS), and for future simulations.

SUMMARY: This research developed urban target acquisition models that could be substituted for existing physics-based or other computationally expensive combat simulation algorithms, resulting in faster simulation runtime with an acceptable loss of aggregate simulation accuracy. Specifically, this research explored 1) the adaptability of probability of line of sight estimates to urban terrain; 2) the use of cumulative distribution functions to model the outcomes when a set of sensors is employed against a set of targets; 3) the use of Markov Chains and Event Graphs to model the transition of a target among acquisition states; and 4) how a system of differential equations may be used to model the aggregate flow of targets from one acquisition state to another. Items (3) and (4) were not developed in depth. Item (1) was very successful and was subsequently passed to AAMSA for further development.

THESIS DIRECTED:

Mlakar, J.A., "Aggregate Models for Target Acquisition in Urban Terrain," Master's Thesis, Naval Postgraduate School, June 2004.

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

KEYWORDS: MOUT, Graph Models

MINE WARFARE SYMPOSIUM
Clyde L. Scandrett, Professor
Department of Applied Mathematics
Sponsor: Naval Postgraduate School

OBJECTIVES: To assist in hosting the 6th International Symposium on Technology and the Mine Problem, which was held 9-13 May 2004 at the Naval Postgraduate School.

SUMMARY: The Symposium was a success, and will likely continue on an every-other-year basis at the Naval Postgraduate School. Funds were used to defray costs accrued by hosting such a large symposium, and for publishing a proceedings and CD's of the Symposium.

PUBLICATION:

Proceedings of the Sixth Symposium on Technology and the Mine Problem, 2004.

DoD KEY TECHNOLOGY AREAS: Sensors, Electronics, Battlespace Environments and Weapons

KEYWORDS: Mines, Mining, Undersea Warfare

REFERENCE/TEXTBOOK ON TECHNOLOGY OF COUNTERING LAND MINES, IEDs AND BOOBY TRAPS

Clyde L. Scandrett, Professor
Department of Applied Mathematics
Sponsor: Office of Naval Research

SUMMARY: Prepared a text/reference book on emerging technologies that are applicable to land countermine (including improvised explosive devices and humanitarian demining). The book was based upon the eleven major scientific symposia and conferences in which Mr. Bottoms had direct responsibilities in planning and organizing. This series began in April 1995 and included six international symposia at the Naval Postgraduate School, three Australian-American conferences in Australia, and a major international conference in Europe at the Free University of Brussels.

KEYWORDS: Land Mines, IEDs

DEPARTMENT OF APPLIED MATHEMATICS

2004
Faculty Publications and Presentations

PUBLICATIONS

Danielson, D.A. and Wilmer, A., "Buckling of Stiffened Plates with Bulb Flat Flanges," *International Journal of Solids and Structures*, Vol. 41, pp. 6407-6427, 2004.

Hamzi, B., Kang, W., and Barbot, J.-P., "Analysis and Control of Hopf Bifurcations," *SIAM Journal on Control and Optimization*, Vol. 42, No. 6, pp. 2200-2220, 2004.

Kang, W., Xi, N., Tan, J., and Wang, Y., "Formation Control of Multiple Autonomous Robots: Theory and Experimentation," *Intelligent Automation and Soft Computing*, Vol. 10, No. 2, pp. 1-17, 2004.

Krener, A.J., Kang, W., and Chang, D., "Control Bifurcations," *IEEE Transactions on Automatic Control*, Vol. 49, pp. 1231-1246, 2004.

Navon, I.M., Neta, B., and Hussaini, M.Y., "A Perfectly Matched Layer Approach to the Linearized Shallow Water Equations Models," *Monthly Weather Review*, 132, No. 6, 1369-1378, 2004.

Owen, G. and McCormick, G., "Factionalism, Violence, and Bargaining in Civil Wars," *Homo Economicus*, 361-390, 2004.

van Joolen, V., Neta, B., and Givoli, D., "A Stratified Dispersive Wave Model with High-Order Non-Reflecting Boundary Conditions," *Computers and Mathematics with Applications*, 48, 1167-1180, 2004.

van Joolen, V., Neta, B., and Givoli, D., "High-Order Boundary Conditions for Linearized Shallow Water Equations with Stratification, Dispersion and Advection," *International Journal Numerical Methods in Fluids*, 46(4), 361-381, 2004.

CONFERENCE PUBLICATIONS

Demetriou, M. and Fahroo, F., "An Adaptive Control Scheme for a Class of Second Order Distributed Parameter Systems with Structured Perturbations," *Proceedings of the IEEE Conference on Decision and Control,* Bahamas, December 2004.

Demetriou, M. and Fahroo, F., "A Natural Observer-Based Adaptive Controller for Structurally Perturbed Second Order Distributed Parameter Systems," *Proceedings of the Mathematical Theory of Networks and Systems (MTNS) Conference*, Leuven, Belgium, July 2004.

Fahroo, F. and Doman, D., "A Direct Method for Approach and Landing Trajectory Reshaping with Failure Effect Estimation," *Proceedings of the American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation and Control Conference*, Providence, RI, August 2004.

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