

WHITE PAPER

MODELING AND SIMULATION AT THE COLLEGE OF WILLIAM AND MARY

Modeling and Simulation has emerged as a leading industry in Hampton Roads over the past five years. Energized by the presence of organizations such as the United States Joint Forces Command (<http://www.jfcom.mil/>), Lockheed Martin's Center for Innovation (<http://www.lockheedmartin.com/innovation>), and others, the Modeling and Simulation (M&S) industry has been a source for economic investment in the region. According to Virginia Business Magazine (May, 2006):

"In 2004, M&S generated \$24 million in state revenue. That amount is expected to grow 125 percent by 2009. By some estimates, the industry already pumps more than \$400 million a year into the Hampton Roads' economy and has created more than 4,000 jobs with salaries twice the local average of \$32,000."

"By 2009, the number of jobs in modeling and simulation here will grow to 7,000...[and] the area M&S industry as a whole will balloon to nearly \$1 billion."

In addition to the financial investment made by the federal government and the private sector, the Commonwealth of Virginia has committed the following financial resources (06-08 biennial budget) to promote and advance Modeling and Simulation related research and instruction in Virginia's institutions of higher learning:

- \$8.5M to Old Dominion University to build research capacity in Modeling and Simulation;
- \$2.7M to Eastern Virginia Medical School to build research capacity in Medical Modeling and Simulation;
- \$600K to the Virginia Economic Development Partnership to support Modeling and Simulation Research specifically and emergency management training simulation; and
- \$400K to the Virginia Community College System to develop instructional programs in Modeling and Simulation.

Source: Virginia Administrative Code, HB5002, 2006 Special Session I

Also notable is the Commonwealth of Virginia's Commonwealth Technology Research Fund that has the objective of, "attract[ing] public and private research funding for institutions of higher education, in order to increase technological and economic development in Virginia" (The Commonwealth of Virginia Technology Research Fund – Guidelines for Applicants, November 2006).

The College of William and Mary (W&M) has made significant contributions through research and strategic alliances that contribute to the position of Hampton Roads as the

location of choice for Modeling and Simulation. A scan of recent W&M research reveals that sixteen (16) academic departments have faculty who have research interests and/or external funding for projects that can be classified as Modeling and Simulation. Selected examples of Modeling and Simulation research activity at The College of William and Mary include:

- The School of Arts and Sciences is actively engaged in M&S related research. Department of Anthropology faculty Dr. Tomoko Hamada Connolly has successfully collaborated with the local M&S company MYMIC (www.mymic.net) to receive two Small Business Innovation Research (SBIR) awards to provide research to 1) further the development of human-response models for military training purposes, and 2) provide data for a M&S model of pandemic health event scenarios. Also notable in the School of Arts and Sciences is faculty from the Department of Anthropology, Department of Government, Department of History, Department of Psychology, and the Thomas Jefferson Program in Public Policy collaborating with MYMIC to submit a Political, Military, Economic, Social, Infrastructure, and Information (PMESII) M&S proposal to the United States Joint Forces Command (JFCOM).
- The Mason School of Business faculty (Dr. Hector Guerrero and Dr. James Bradley) working with The City of Portsmouth through the W&M Economic Development Office to model transportation patterns as a means to identify solutions to improve traffic flow that will coincide with the planned expansion of the ports in Hampton Roads; the Mason School of Business faculty also completed a Transportation Safety Administration (TSA) program that simulates shipping movements during port disasters.
- Research conducted by Dr. Harry Wang and his team (Virginia Institute of Marine Sciences - VIMS) to “determine the nature and possible extent of the physical changes that may result in the estuarine environment of Hampton Roads...using model simulation techniques” (www.vims.edu/craney).
- The School of Education (in collaboration with the Office of Naval Research) leading the Virginia Demonstration Project for the Naval Research – Science & Technology for America’s Readiness (N-STAR). The primary objective of this project was to increase the awareness of children to careers in science, technology, engineering and math. An activity to accomplish the aforementioned objective is having the children simulating finding underwater land mines using a machine they build using Lego Mindstorm kits.
- The SciClone Cluster Project (directed by Dr. John van Rosendale) that supports “large-scale computations in disciplines such as physics, chemistry, mathematics, biology, and marine science...research and development of algorithms, methodologies, and tools to support scientific computing on parallel and distributed systems...[and] experimental research on a wide range of topics in

computer science and numerical computing” (www.compsci.wm.edu). A partial listing of the research projects that have utilized the SciClone Cluster Project are:

- Modeling the Internal Magnetic Fields in Superconductors;
- Parallel Simulation of an Artificial Society Model;
- Parallel Methods for Graphics and Visualization; and
- Three-Dimensional Ocean Model of Hydrodynamics and Sediment Transport.

Also important to note is the collaborative M&S research with a local bioinformatics company INCOGEN (www.incogen.com) and the Eastern Virginia Medical School (www.evms.edu) using the SciClone Cluster Project.

- W&M’s Center for Real-time Computing is transforming “conventional neurosurgery” with its Image Guided Neurosurgery (IGNS). “This research allows surgeons to understand what is going on inside a patient’s brain while the tissue resection is underway” through imaging. This results in, “...a better possibility for good outcome of the operation and improved quality of [the patient’s] life afterwards” (http://www.cs.wm.edu/~zichu/image_guided_neurosurgery.htm).

Other medical M&S research at W&M include:

- Use of MALDI-TOF Mass Spectra for Disease; and
- Mass Spectrometry Data Analysis for Proteomics (cancer diagnosis)

W&M is actively seeking partnerships with other universities, government organizations, and the private sector. W&M partnered with the Virginia Modeling Analysis and Simulation Center (VMASC) to submit two proposals to fund Centers of Excellence. The proposal to create a Department of Homeland Security Center of Excellence in Natural Disasters, Coastal Infrastructure, and Emergency Management was unsuccessful. The proposal to create a Department of Homeland Security Center of Excellence for Maritime Domain Awareness and Natural Disasters is still pending.

W&M is also a partner in the Hampton Roads Research Partnership (HRRP) and is an active supporter of the M&S cluster that HRRP is promoting. W&M has collaborated in a proposal organized by the Hampton Roads Partnership seeking to expand state funding for M&S collaborations. W&M has several private sector partners exploring M&S collaborations, including Werner Anderson (www.werneranderson.com), MYMIC (www.mymic.com), and INCOGEN (www.incogen.com).

Although W&M does not have a “formal” Modeling and Simulation Department or Program, the breadth and depth of research that utilizes Modeling and Simulation suggests that M&S is clearly an emerging research strength. At the direction of the W&M Vice Provost for Research and Graduate Professional Studies, Dr. Dennis Manos, and the Director of the Computational Science Cluster, Dr. John van Rosendale, the *primary* focus of M&S research at W&M will focus on the following areas in which the college has unique capabilities:

- Coastal wind-driven water levels, including waves;
- Transportation equations for satisfactory homeostasis and/or re-optimization of seriously perturbed networks; and
- Next generation virtual environments.

To assist in moving M&S related research activity forward at W&M, the Office of Economic Development has identified the following goals and milestones for 2007-2008:

- Meeting between Dr. James R. Golden (W&M Associate Vice President for Economic Development) and Lieutenant General Bob Wood (Joint Forces Command) to discuss M&S support W&M can provide to Joint Forces Command);
- Assist in the development of a Hampton Roads M&S legislative funding proposal with other research universities in the region;
- Partner with M&S companies to develop, write, and submit Small Business Innovative Research (SBIR) funding proposals;
- Continue to develop a strong collegial relationship with the Virginia Modeling and Simulation Center (VMASC) in an effort to identify joint projects including the Multidisciplinary University Research Initiative (MURI) for maritime security; and
- Utilize the W&M Technology and Business Center to assist in the development and expansion of M&S related small businesses through the Workforce Innovation in Regional Economic Development (WIRED) grant received from the United States Department of Labor for the Southeastern Virginia Portal Project.

As result of the successful completion of the aforementioned M&S goals and milestones for 2007-2008, W&M will have achieved the following outcomes:

- Increased collaborative research;
- Increased sponsored research funding;
- Creation of entrepreneurial enterprises; and
- Recognition of W&M as a significant contributor to the Modeling and Simulation research base in Hampton Roads.

**MODELING AND SIMULATION RELATED RESEARCH
AT
THE COLLEGE OF WILLIAM AND MARY**

**MARINE SCIENCE / MARINE ECOSYSTEM MODELING /
COASTAL WIND-DRIVEN WATER LEVELS**

Dr. Carl Friedrichs (Ph.D., Massachusetts Institute of Technology). Professor of Marine Science.

Dr. Friedrich's long term research goal is to better understand fundamental aspects of coastal and estuarine physics which control sediment and other material fluxes at time and scale length scales important to geology, biogeochemistry, and ecology. His technical approach involves field work, analytical theory, numerical modeling and the interaction of all three in the utilization of coastal observation and prediction systems.

Dr. Marjy Friedrichs (Ph.D., Old Dominion University). Research Assistant Professor of Marine Science.

Dr. Friedrichs uses numerical models to better understand how and why primary production, and associated export of carbon, varies among diverse marine environments. Her research involves the application of a number of different types of marine ecosystem models in combination with data assimilation and remotely-sensed ocean color data to study a variety of interdisciplinary oceanographic questions of marine biogeochemical relevance.

Dr. Courtney Harris (Ph.D., University of Virginia). Alumni Memorial Term Distinguished Associate Professor of Marine Science.

Dr. Harris' research has been directed at improving our ability to quantify and predict sediment transport on continental shelves and within estuaries. Her recent research includes developing three-dimensional numerical models of the processes that distribute fluvially-derived sediment for the northwest Adriatic Sea, and off-shore of sediment-laden rivers in northern California and New Zealand. She also is developing three-dimensional numerical models for the Chesapeake Bay and Gulf of Mexico that incorporate feedbacks between physical and biological processes. She works within a group who are developing a three-dimension community models for sediment transport and oceanographic circulation.

Dr. Jerome P.Y. Maa (Ph.D., University of Florida). Professor of Marine Science.

Dr. Maa is interested in cohesive sediment dynamics and water wave transformations. His studies on cohesive sediment dynamics include field experiments and data analysis in order to understand the processes, and propose improvements on current formulations for numerical modeling. He has proposed a rather simple formulation for erosion and currently working on settling, deposition and consolidation. His research on modeling water wave transformation includes understanding the wave effects on shoreline changes,

how to protect the shoreline and how to provide the best shelter to reduce the impact of wind waves, as well as long waves, on harbor operations.

Dr. Jesse McNinch (Ph.D., University of North Carolina). Assistant Professor of Marine Science.

Dr. McNinch researches shoreline behavior (erosional hotspots) and its relationship to underlying geology. His research approach involves field observations coupled with a modeling component.

Dr. Harry Wang (Ph.D., Johns Hopkins University). Associate Professor of Marine Science.

Dr. Wang's research interests are in coastal and estuarine physical processes and the consequence of their transport properties. His recent works emphasize the use of numerical computational methods to simulate the current, water level, salinity, and temperature as well as their coupled environmental conditions such as water quality, sediment and larval transport. Dr. Wang's current projects include: Water Quality Modeling in the Baltimore Harbor; Watershed and Water Quality Modeling in the Upper Western Shore of Maryland; and the Craney Island Eastward Expansion Project.

Dr. John Wells (Ph.D., Louisiana State University). Dean of the School of Marine Science and Director of the Virginia Institute of Marine Science.

Dr. Wells' research focus is in the field of coastal Marine Geology with emphasis on the sedimentology and morphology of clastic sedimentary environments and the physical processes that shape their evolution. His research provides observational data that has fundamental and immediate relevance to a range of modeling efforts in marine ecosystems. Dr. Wells has conducted field studies in the central North Carolina beach and cape shoal environments, the Neuse River and Pamlico Sound, the Mississippi and Atchafalaya River Deltas, the west coast of Korea, the northeastern coast of South America, and Lake Malawi in east Africa.

TRANSPORTATION

Dr. Prabhu Aggarwal (Ph.D., University of Washington). Associate Professor of Operations and Information Technology.

Dr. Aggarwal's teaching interests are in the areas of project management, inventory and logistics issues in supply chains, operations strategy, and quantitative modeling. His research interests include: stochastic models of inventory systems, queuing systems theory, demand management, and project scheduling.

Dr. James Bradley (Ph.D., Stanford University). Professor of Operations and Information Technology.

Dr. Bradley teaches operations management and information management. He has worked with the City of Portsmouth, Virginia to assess and improve transportation patterns that will be affected by the expansion of the port industry in Hampton Roads.

Dr. Hector Guerrero (Ph.D., University of Washington). Associate Professor of Operations and Information Technology.

Dr. Guerrero's areas of interest includes: process design, product design, manufacturing planning and control, quality, manufacturing, decision making, service, and production scheduling. He has worked with the City of Portsmouth, Virginia to assess and improve transportation patterns that will be affected by the expansion of the port industry in Hampton Roads.

Dr. David Murray (Ph.D., University of Michigan). Assistant Dean of Information Technology and Clinical Assistant Professor.

Dr. Murray's research interest focus on the role that information technology plays in manufacturing and supply chain design and analysis, with emphasis on the ways that information technology can be used to improve the coordination of value-adding activities among firms in the furniture chain. His focus in these areas has lead to the development of comprehensive computer-based simulation models.

Dr. John Strong (Ph.D., Harvard University). CSX Professor of Business Administration Economics and Finance.

Dr. Strong has written extensively on the airline industry economics and safety issues, on economics and finance in developing countries, and on project finance in transport. He has taught workshops on transport issues for the World Bank in Latin America, the Middle East, Africa, India, and Southeast Asia. He has also served as a consultant to the World Bank, the European Bank for Reconstruction and Development, the Inter-American Development Bank, the United States Department of Transportation and the Antitrust Division of the United States Department of Justice. His other areas of interest include economic issues of the former Soviet Union and Economic Issues in China.

William O'Connell, Professor of Economics and Finance.

Professor O'Connell's areas of interest include transportation and logistics and railroad operations and management.

NEXT GENERATION VIRTUAL ENVIRONMENTS

Dr. Jennifer Stevens (Ph.D., Emory University). Assistant Professor of Psychology. Dr. Stevens is the Director of the William and Mary Cognitive Neuroscience Lab. Her research interests include cognitive neuroscience of representation, perception, and execution of action; and motor recovery in patient populations.

Dr. John van Rosendale (Ph.D., University of Illinois). Director of Computational Science for the College of William and Mary's Interactive Graphics Laboratory. Dr. van Rosendale's research focuses on auto-stereo virtual environments, tele-immersion, and advanced modeling and simulation – the components of future environments for both training simulation and tele-collaborative combat operations. Dr. van Rosendale has been employed as a researcher with the National Aeronautics and Space Administration (NASA), and he has worked for the National Science Foundation (NSF) and the United States Department of Energy.

Dr. Peter Vishton (Ph.D., Cornell University). Assistant Professor of Psychology and Graduate Director. Dr. Vishton's research interests include cognitive, perceptual, and motor development; and interaction of vision and action systems.

PMESII (Political, Military, Economic, Social, Infrastructure, and Information)

Dr. David Backer (Ph.D., University of Michigan).

Assistant Professor of Government. Dr. Backer specializes in the study of authoritarian regimes (coalition dynamics, liberalization), post-conflict transitions (elections, constitutional design, power sharing), and comparative human rights (transitional justice, genocide, refugees), with a particular emphasis on Africa. His research projects include collaborations on computer-aided simulations of the dynamics of episodes of ethnic conflict, as well as leadership decision-making in autocracies, using agent-based modeling methodology. He has served as a Principal Investigator on grants from the Department of Defense, the National Science Foundation, and the United States Institute of Peace.

Dr. Donald Baxter (Ph.D., Syracuse University). Professor Emeritus of Government.

Dr. Baxter's research interests include South and Southeast Asian politics.

Dr. James Bill (Ph.D., Princeton University). Professor Emeritus of Government.

Dr. Bill's research interest includes comparative politics in the Mideast.

Dr. T. J. Cheng (Ph.D., UC Berkeley). Class of 1935 Professor of Government.

Dr. Cheng's research interests include comparative political economy and East Asian development.

Dr. Clay Clemens (Ph.D., Tufts University). Chancellor Professor of Government.

Dr. Clemens' research specialization is German politics and foreign policy. He has also served as a political analyst at the United States Embassy in Bonn, Germany.

Dr. David Dressler (Ph.D., Johns Hopkins University). Associate Professor of Government.

Dr. Dressler's primary teaching emphasis are international relations and qualitative methods. He was a founding member of the Consortium for Qualitative Research Methods and taught at the Qualitative Methods Institute at Arizona State University.

Dr. Melvin Patrick Ely. William R. Kenan Jr. Professor of Humanities.

Dr. Ely is a Newton Family Professor of History. He has won numerous awards for his teaching excellence, including a Virginia Commonwealth Outstanding Faculty Award, the Prize for Outstanding Scholarly Publication and Research while teaching at Yale and the Yale College Prize for Teaching Excellence. He has multiple book publications, and he won the Wesley-Logan Prize for best book on the history of the African Diaspora. For his book, *Israel on the Appomattox*, Dr. Ely won the Bancroft Prize, the Beveridge Prize, and the Library of Virginia Literary Award. Dr. Ely served as Fulbright Professor of American Studies at the Hebrew University of Jerusalem. He has also participated in writing Small Business Innovation Research (SBIR) proposals.

Dr. David Feldman (Ph.D., Duke University). Professor of Economics, University Professor for Teaching Excellence.

Dr. Feldman's research explores the political economy of trade liberalization, economic integration and election models. His current research interests include the cost, price, and efficiency of higher education in the United States as well as international economics in the areas of comparative national price levels, political-economy of trade policy, and economic integration.

Dr. William Fisher (Ph.D., Cornell University). Associate Professor of Anthropology.

Dr. Fisher's research centers on the way changes in environment, social relations and minds occur and how these are understood and described by social actors in ways that feed back into a matrix of biophysical and meaningful causality. He has published research on gender relations, ritual, and social movements.

Dr. Tomoko Hamada-Connolly (Ph.D., UC Berkeley). Professor of Anthropology.

Dr. Hamada-Connolly's primary research focus is the culture of complex organization. This has allowed her to conduct fieldwork on multinational corporations in Japan, China, South Africa, Spain, and the United States. Her research interests also include global team development, deployment of information technology, and collaborative learning in multinational settings. She recently participated in the development of successful Small Business Innovation Research (SBIR) grants with a regional modeling and simulation company.

Dr. Eric Jensen (Ph.D., University of Michigan). Professor of Economics, Director of the Thomas Jefferson Program in Public Policy.

Dr. Jensen's research includes the allocation of resources within households and societies, and subsequent fertility, mortality and health impacts with attention to the formulation and evaluation of population and health policies. His research in these areas has allowed Dr. Jensen to work in Bangladesh, Indonesia, the Philippines, Romania, and Thailand. He has consulted for the World Bank and the United States Agency for International Development. He teaches cross-section econometrics and introductory econometrics, and he has taught benefit-cost analysis, principles, and a seminar in Population Economics.

Dr. Harvey Langholtz (Ph.D., University of Oklahoma). Professor of Psychology.

Dr. Langholtz's research interests include applied decision making theory and behavioral aspects of international diplomacy. He has also served as a Senior Special Fellow for the United Nations Institute for Training and Research.

Dr. Carl Moody (Ph.D., University of Connecticut). Professor of Economics.

Dr. Moody teaches mathematical economics, econometrics, and time series analysis. His most recent research is the economic analysis of crime and criminal justice policy. He has served as a Consultant for the Sanford Research Institute, Virginia Marine Resources Commission, United States Department of Energy, National Center for State Courts, Oak Ridge National Laboratories, and other prestigious organizations.

Dr. Danielle Moretti-Langholtz (Ph.D., University of Oklahoma). Research Assistant Professor of Anthropology.

Dr. Moretti-Langholtz specializes in cultural anthropology, American Indians, museology, life history; North America. She is currently engaged in the studying of the political resurgence of Virginia Indians during the twentieth century. She is also gathering oral histories of Virginia Indian tribal leaders, and is working to establish an archive to preserve documents from the eight state-recognized tribes. Dr. Moretti-Langholtz has also participated in writing Small Business Innovation Research (SBIR) proposals.

Dr. John Nezlek (Ph.D., University of Rochester). Professor of Psychology.

Dr. Nezlek's research interests include social and personality psychology with a cross-cultural emphasis, naturally occurring social interaction, within-person variability, multilevel modeling, and interval and event contingent data collection methods.

Dr. Amy Oakes (Ph.D., Ohio State University). Assistant Professor of Government.

Dr. Oakes' research interests include international security, comparative foreign policy, and quantitative methods.

Dr. Graham Ousey (Ph.D., Louisiana State University). Associate Professor of Sociology.

Dr. Ousey's primary research interests are guided by the notion that the emergent products of human social organization, including: social institutions, forms of social control, associational networks, vertical/horizontal segmentation, and cultural differentiation. His research activities include macro-level of analysis to explore how aspects of social stratification, social change, local social institutions and illicit labor markets affect variation in rates of violent crime across macro-social units, such as cities and counties.

Dr. Sue Peterson (Ph.D., Columbia University). Reves Professor of Government and International Relations.

Dr. Peterson's research interests include international relations. She has taught courses in international relations, foreign and national security policy, United States Foreign Policy and Film.

Dr. Mitchell Reiss. Vice Provost for International Affairs.

Dr. Reiss has served as Director of Policy Planning at the U.S. State Department and as the President's Special Envoy for the Northern Ireland Peace Process with the rank of Ambassador. He helped establish the Korean Peninsula Energy Development Organization (KEDO), a multinational organization created to address weapons proliferation concerns in North Korea. Dr. Reiss' government service includes positions in the National Security Council at the White House, and as a Consultant to the United States Arms Control and Disarmament Agency, the State Department, the Congressional Research Service, the Lawrence Livermore and Los Alamos National Laboratories.

Dr. John Strong (Ph.D., Harvard University). CSX Professor of Business Administration Economics and Finance.

Dr. Strong has written extensively on the airline industry economics and safety issues, on economics and finance in developing countries, and on project finance in transport. He has taught workshops on transport issues for the World Bank in Latin America, the Middle East, Africa, India, and Southeast Asia. He has also served as a consultant to the World Bank, the European Bank for Reconstruction and Development, the Inter-American Development Bank, the United States Department of Transportation and the Antitrust Division of the United States Department of Justice. His other areas of interest include economic issues of the former Soviet Union and Economic Issues in China.

Dr. Yanfang Tang (Ph.D., Ohio State University). Associate Professor of Chinese.

Dr. Tang teaches both language and literature/culture classes including: Understanding Contemporary Chinese Society and Chinese Behavioral Patterns in Social Communication. She has also collaborated to publish a book, Advanced Chinese: Intention, Strategy and Communication.

APPLIED SCIENCES

Dr. Eric Bradley (Ph.D., UC Santa Barbara). Chair, Applied Science and Professor of Biology.

Dr. Bradley is engaged in research that will result in the development of very high resolution Single Photon Emission detectors that are used in a dual modality imaging system with X-ray. Dr. Bradley is also working to develop the associated Computed Tomography software and hardware for in vivo SPECT imaging of both gene expression as well as for pharmacodynamic studies of iodine-labeled ligands.

Dr. Christopher A. Del Negro (Ph.D., UC Los Angeles). Assistant Professor of Applied Science.

Dr. Del Negro examines the brain mechanisms that generate and control breathing behavior in humans and all mammals. The critical questions pertain to neuroscience and the need to understand rhythmic functions in brain networks in general, as well as specific physiological issues regarding regulatory and homeostatic functions of the brain. Dr. Del Negro's team has developed contemporary models of respiratory neurons based on their experimental studies, which they assemble into functional networks that mimic respiratory rhythm. These models are both didactic and predictive and are used in a marriage of experimental and theoretical investigations of mammalian neural control of breathing.

Dr. R. Alejandra Lukaszew (Ph.D, Wayne State). VMEC Associate Professor of Applied Science.

Dr. Lukaszew's research encompasses the study of magnetic and metallic materials and their structure/property correlations at the nano-scale as well as the control of the magnetic anisotropy in thin films and nanostructures. Her work includes developing phenomenological models to understand magnetization dynamics in these materials. Her research is aimed at elucidating problems of interest to the magneto-recording, magneto-electronic and magnetic sensing industries.

Mark Hinders (Ph.D., Boston University). Professor of Applied Science.

Dr. Hinders conducts research in wave propagation and scattering phenomena, applied to medical imaging, intelligent robotics, security screening, remote sensing and nondestructive evaluation. His other areas of research interest include the development of new non-invasive medical diagnostics and insitu sensing techniques for on-line process control in high-value-added manufacturing. In theoretical modeling, numerical simulation and laboratory experiments, this research is directed towards developing a deeper understanding of physical processes that can lead to novel nondestructive measurement tools.

Dr. Dennis Manos. Vice Provost for Research and CSX Professor of Applied Science.

Dr. Manos' group performs research in the fundamental science which underlies the formation and characterization of surfaces and interfaces with particular specialized properties. Research includes plasma-surface interactions, surface cleaning and

passivation, surface modification by particle and photon bombardment, and other areas of fundamental and applied importance. This research is critical to the success of controlled nuclear fusion, high-speed aeronautics, high speed rail transport, communications, and other initiatives.

Dr. Leah Shaw (Ph.D., Cornell University). Assistant Professor of Applied Science.

Dr. Shaw's research is in the area of dynamics of nonequilibrium systems with a focus on epidemic dynamics. Her group is developing models to understand the role of social networks in disease propagation and the effects of stochastic fluctuations. The models are compared with epidemiological data. This research is directed towards better prediction of epidemic dynamics and development of new disease control strategies.

Dr. Gregory Smith (Ph.D., UC Davis). Associate Professor of Applied Science.

Dr. Smith's research includes developing a probability density approach to modeling important stochastic aspects of local Ca^{2+} signaling in cardiac myocytes (related to congestive heart failure). Dr. Smith has also engaged in computational neuroscience research to understand the function of inhibitory neurons associated with the lateral geniculate nucleus.

Dr. Robert L. Vold (Ph.D., University of Illinois). Professor of Applied Science.

Professor Vold uses high field nuclear magnetic resonance (NMR) to investigate molecular structure and dynamics in solid materials. He is internationally recognized for developing simulation procedures for NMR spectra and relaxation times of deuterons and other quadrupolar nuclei, that result in quantitative information about microdynamics of complex systems, ranging from disordered ferroelectric ceramics to biologically important oligopeptides and oligonucleotides. The software developed and maintained by Dr. Vold's group for this purpose is currently in use in more than one hundred laboratories worldwide.

MARINE SCIENCE

Dr. John Brubaker (Ph.D., Oregon State University). Associate Professor of Marine Science.

Dr. Brubaker's current projects include Detection and Prediction of Water-borne Hazards and Threats in Ports and the Littoral Zone: A Lower Chesapeake Bay Test Bed; Chesapeake Bay Observing System Cooperation Expansion and Integration Demonstration; and Three-Dimensional Structure and Kinematics of a Tidal Eddy. Dr. Brubaker is also interested in water levels in connection storm surge inundation.

Dr. Mark Brush (Ph.D., University of Rhode Island). Assistant Professor of Marine Science.

Dr. Brush is a coastal systems ecologist and numerical modeler. His research focuses on the oceanography, ecology, and biogeochemistry of coastal marine ecosystems. His modeling program is focused on the exploration of innovative numerical modeling techniques that incorporate a combination of mechanistic, empirical, and statistical approaches for the purpose of: heuristic study of ecosystem structure and function; and increasing model utility for management applications. A major focus of Dr. Brush's work involves critical evaluation of model formulations, how best to represent biological processes in mathematical form, and development of alternative formulations when traditional ones fail. Selected current projects include: Modeling Tools to Predict Hypoxia/Anoxia in Upper Narragansett Bay; Modeling Atlantic Menhaden in Support of Nutrient and Multispecies Management; and Development of Watershed and Estuarine Models of the New River Estuary.

Dr. John Hoenig (Ph.D., University of Rhode Island). Professor of Marine Science.

Dr. Hoenig's research interests include developing methods for studying population dynamics and assessing fisheries including determining appropriate management options. He uses statistical theory, mathematical modeling, and computer simulation to develop methods for interpreting tagging, survey, catch, effort, and age data.

Dr. Robert Latour (Ph.D., North Carolina State University). Assistant Professor of Marine Science.

Dr. Latour's research emphasis includes mechanistic modeling techniques to understand fish population dynamics. Selected current projects of his includes: Modeling Atlantic Menhaden in Support of Nutrient and Multispecies Management; and Data Collection and Analysis in support of multispecies stock assessments in the Mid-Atlantic: Northeast Area Monitoring and Assessment Program Nearshore Trawl Program.

Dr. Roger Mann (Ph.D., University of Wales). Professor of Marine Science.

Dr. Mann's research interests includes physiological ecology of marine mollusks, larval dispersal and settlement processes in estuarine and shallow water systems, fisheries and aquaculture of marine mollusks, and invasion biology and ballast water technologies. Selected current projects of Dr. Mann includes: population models of the Chesapeake

oyster resources; dispersal processes in estuarine systems; and population demographics, growth rates, and age structure for Chesapeake hard clam resources.

Dr. Michael Newman (Ph.D., Rutgers University). Professor of Marine Science.

Dr. Newman's research interests include ecotoxicology, general and applied aquatic ecology, containment effects on populations, bioaccumulation, factors modifying inorganic containment toxicity, fate of inorganic contaminants in aquatic systems, quantitative methods for ecological risk assessment, toxicity models, and water quality. Current projects of Dr. Newman include: Stochastic modeling of containment exposure from fish consumption; Improving prediction of lethal effects with time-to-death methods; and Models predicting mortality with pulsed exposure to toxicants.

Dr. Deborah Steinberg (Ph.D., UC Santa Cruz). Associate Professor of Marine Science.

Dr. Steinberg's research interests are in zooplankton ecology and physiology, coastal and deep-sea food webs, nutrient cycling, and marine detritus ("marine snow"). Her current projects include: Vertical Transport in the Global Ocean; and Quantification and Modeling of DOC and DON Release of Marine Systems: A Study of Increasing Trophic Complexity; and Development of an Operational Model for Predicting the Near Real Time Distribution and Abundance of the Schyphomedusa.

PHYSICS

Dr. Keith A. Griffioen (Ph.D., Stanford University). Professor of Physics.

Professor Griffioen's area of expertise is in experimental subatomic physics. He studies the quarks and gluons in the neutron and proton using electron accelerators such as the one at Jefferson Lab in Newport News, Virginia. These experiments require large, complex detector systems that are modeled with detailed Monte Carlo simulations.

Dr. William Kossler (Ph.D., Princeton University). Professor of Physics.

Dr. Kossler has interests in modeling particle reactions and production. These have applications in positron production at Jefferson Laboratory. Beam transport is also of interest. He also models the magnetic field distributions in high temperature superconductors as part of the process of analyzing muon spin rotation data. Fitting of data to relatively complex non-linear functions is part of this process.

Dr. Henry Krakauer (Ph.D., Brandeis University). Professor of Physics.

Professor Krakauer's area of expertise is in computational physics. He has developed *ab initio* computational methods for high-performance computing to tackle significant problems in technologically important materials, such as piezoelectrics and high-temperature superconductors.

Dr. Eugene R. Tracy (Ph.D., University of Maryland, College Park). Chancellor Professor of Physics.

Professor Tracy's area of expertise is in mathematical physics and nonlinear dynamics. He has worked on the basic theory of waves, with applications to ocean waves, fusion plasmas and nonlinear optical systems. He has also worked on problems in time series analysis for complex systems, including protein mass spectrometry.