EASTERN VIRGINIA
MEDICAL SCHOOL

THE VIRGINIA MODELING AND SIMULATION INITIATIVE (VIMSIM)

REPORT ON THE BUILDING OF RESEARCH CAPACITY IN MEDICAL MODELING AND SIMULATION FOR THE BIENNIUM ENDING JUNE 30, 2008

Presented to:

The Honorable Lacey E. Putney
Chairman
House Appropriations Committee

And

The Honorable Charles J. Colgan
Chairman
Senate Finance Committee

By

C. Donald Combs, Ph.D.
Vice Provost for Planning and Health Professions
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October 1, 2008

Table of Contents

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October 1, 2008

The Honorable Lacey E. Putney
Chairman, House Appropriations Committee
Commonwealth of Virginia
9th Floor, General Assembly Building
910 Capitol Street
Richmond, VA 23219

The Honorable Charles J. Colgan
Chairman, Senate Finance Committee
Commonwealth of Virginia
10th Floor, General Assembly Building
910 Capitol Street
Richmond, VA 23219

Dear Delegate Putney and Senator Colgan,

Under Item Number 246, paragraph B, of the 2008 Virginia Acts of Assembly – Chapter 879, the Eastern Virginia Medical School (EVMS) is required to report to the Chairmen of the House Appropriations and Senate Finance Committees by October 1, 2008 on the use of $1,500,000 from the general fund and $1,200,000 from nongeneral funds in each of the state fiscal years 2007 and 2008 to build research capacity in medical modeling and simulation.

A headline in *The Virginian-Pilot* newspaper stated "MODSIM Expo's Turnout Exceeds Expectations", referring to the unexpectedly large turnout of attendees for the inaugural modeling and simulation conference we co-sponsored in September 2007 in Virginia Beach. This headline would also be appropriate to describe the first biennium of the medical modeling and simulation component of the Virginia Modeling and Simulation Initiative (VIMSIM). All the projects we had planned to undertake were indeed started and we exceeded the $2.4 million required in nongeneral matching funds by approximately 350%.

The report requested has been included in the required format along with several attachments that highlight the recent accomplishments of EVMS and its medical modeling and simulation research partner, Old Dominion University's Virginia Modeling, Analysis and Simulation Center.

Please do not hesitate to contact me for any further information that may be required.

With best regards,

C. Donald Combs, Ph.D.
Vice Provost for
Planning and Health Professions

Attachments
Katherine K. Hanley, Secretary of the Commonwealth

Building Research Capacity in Medical Modeling and Simulation

Report to the

House Appropriations Committee

and

Senate Finance Committee

Eastern Virginia Medical School

October 1, 2008

Background and Problem Statement

Several studies have revealed that the U.S. health care system is not as safe as it should be. For instance, in a study of Medicare data collected from over 5,000 hospitals across all 50 states from 2002-2005, the HealthGrades organization (2007) found that 284,798 patients had died from safety incidents (e.g., failure to rescue, foreign bodies left during a procedure, infections due to medical care, etc.) with an estimated cost of $8.6 billion. Further, more than 85% of those deaths were potentially preventable. Research has shown that equipment and instruments, the ergonomic design of equipment, individual performance, team and group behavior, organizational practices, legal and regulatory constraints, and societal and cultural pressures all contribute to errors in the health care system (Bogner, 1994). Further, the American Medical Association's Accreditation Council for Graduate Medical Education (ACGME), the organization that accredits graduate medical education programs in the U.S., recently set restrictions on the working hours of medical residents. These restrictions have raised new concerns about how to provide adequate training opportunities for medical residents.

In many high-risk occupations (e.g., aviation, military operations, nuclear power plant operations, etc.), computer-based simulators have been an historical and fundamental component of training. Not only do simulators provide a safe environment for trainees to acquire skills, but they also facilitate our understanding of human performance in those contexts.

By contrast, computer-based simulator systems for training healthcare providers have only become commercially viable within the last 10 years. However, the number and variety of medical simulator systems are increasing rapidly. These simulator-based training systems promise many advantages. They enable trainees to learn fundamental procedures without putting patients at risk. They allow greater opportunities for training to be matched to individual needs and can expose trainees to rare or unusual conditions. They also reduce the need for cadavers and animal models. Moreover, evidence is beginning to show that clinicians who train with this technology are more skillful when they perform procedures on genuine patients. Consequently, a growing number of residency review committees are now considering how to use this technology for assessment and certification.

Unfortunately, simulation technology has not yet had the impact on medical curricula that one might hope. There are a number of issues that continue to impede its acceptance. First, there are few studies demonstrating training effectiveness that are grounded in fundamental principles of skill acquisition or learning. Thus, many systems are not designed to take full advantage of an individual's potential for learning. Similarly, training regimens do not include current methods for validating skills and expertise. Second, there are large gaps between those systems that are currently available and the needs of medical educators. For instance, most current commercial systems address the psychomotor skills needed to perform individual procedures. There are few systems, however, that target the problem-solving and decision-making skills of more advanced trainees. Third, there are also gaps between current commercial systems and the needs across all medical specialties. The vast majority of systems available today target anesthesiology, airway management, and laparoscopic surgery. Few systems exist for training in specialties such as family medicine or obstetrics and gynecology.

Bogner, M.S. (1994). Human error in medicine. Hillsdale, NJ: Erlbaum.
HealthGrades, Inc. (2007). HealthGrades quality study: Fourth annual patient safety in American hospitals. Lakewood, CO: Author.

Virginia's Response in the FY 2006-2008 Biennium

On April 12, 2005 former Governor Mark R. Warner announced the Virginia Modeling and Simulation Initiative, known by the acronym VIMSIM, at the opening of Lockheed Martin's Center for Innovation in northern Suffolk. Governor Warner described the potential impact of VIMSIM on that day as follows:

"VIMSIM has the potential to dramatically transform and strengthen the economy of this region and the Commonwealth as a whole by attracting more high-tech, high-wage jobs…We can make this the beginning of the biggest economic development force, not only for Hampton Roads, but for all of Virginia".

In December of 2005 Governor Warner announced a $27 million package of budget proposals to broaden and build upon the growing modeling and simulation activity in South Hampton Roads. The package included funds to recruit and hire additional faculty and staff to expand research and training programs in modeling and simulation at Old Dominion University (ODU), Eastern Virginia Medical School (EVMS), and Tidewater Community College (TCC).

EVMS developed a six-year initial funding plan for investment in medical modeling and simulation in coordination with ODU's Virginia Modeling, Analysis and Simulation Center (VMASC), its research partner, as follows:

	GF	NGF
FY07	$1.85M	$1.00M
FY08	1.85M	1.25M
FY09	1.50M	1.50M
FY10	1.00M	2.00M
FY11	.750M	2.50M
FY12	.750M	3.00M
	$7.70M	$11.25M

The initial EVMS request was for a total of $7.70 million in general funds over the six-year period that would, in turn, leverage $11.25 million in nongeneral funds while establishing the Commonwealth and Hampton Roads as a national and international center of excellence in medical modeling and simulation.

With the support of Governor Timothy M. Kaine and the General Assembly, EVMS was appropriated $1.5 million from the general fund and $1.2 million from nongeneral funds in each year of the FY 2006-2008 biennium to build research capacity in medical modeling and simulation. While the general funds appropriated fell somewhat short of what was requested, EVMS has made the most of the investment and has exceeded the goal of securing $2.4 million in nongeneral matching funds during the biennium by approximately 350%.

For the current FY 2008-2010 biennium, EVMS had requested a modest increase in funding to $2.0 million in general funds for each year of the biennium and planned to leverage these dollars with a minimum of $2.0 million in nongeneral funds in FY 2009 and $2.5 million in nongeneral funds in FY 2010. This funding would have covered years 3 and 4 of the initial six-year medical modeling and simulation investment plan and would have been a prudent use of the Commonwealth's funding considering the results obtained with the $3.0 million in general funds invested in medical modeling and simulation activities at EVMS in the FY 2006-2008 biennium. If past is prologue, the nongeneral fund return on this investment would likely have substantially

exceeded the conservative estimate used in this proposal. Unfortunately, however, the Commonwealth's fiscal challenges resulted in a general funds appropriation of $562,500 in each year of the FY 2008-2010 biennium for the VIMSIM medical modeling and simulation component.

The General Assembly included language in the Appropriations Act for the FY 2006-2008 biennium stipulating that EVMS should report on the use of the medical modeling and simulation research capacity-building funds on an annual basis. The report must include the following information: 1) how the funds were used, 2) the amount of federal and private funds that were leveraged, 3) collaborative efforts in support of private industry, 4) the number of junior and senior faculty recruited in each field, 5) the amount of federal or other private grant funds received as the result of those recruitments, 6) additional grants or contracts being pursued, 7) the level of instructional activity conducted by these faculty, 8) the impact of research activities on undergraduate instruction, 9) the use of graduate student aid funds, and 10) recommendations for future investment.

The requested information is presented here for the FY 2006-2008 biennium to highlight the impact that the $3.0 million investment in medical modeling and simulation research capacity has already had on the Commonwealth, in these first two years of investment. Supplementary information has also been provided where noted in the narrative.

1) <u>How the funds were used.</u>
   At Old Dominion University (ODU), funds were used to support the hiring of eight (8) new ODU faculty members with medical modeling and simulation research interests and the reallocation of effort of an additional six (6) current ODU faculty members and three (3) staff project scientists/engineers. In addition the funds supported seven (7) master's level students and nine (9) doctoral level students. At EVMS, the funds were used to reallocate the research effort of eleven (11) current EVMS faculty along with several staff members, and to support the work of three (3) master's level students and three (3) doctoral level students. In addition, $203,000 in funds was used to purchase medical modeling and simulation research equipment.

2) <u>The amount of federal and private funds that were leveraged.</u>
   A total of $8,409,465 in federal and private funds was leveraged by the $3.0 million in general funds provided by the Commonwealth in the FY 2006-2008 biennium. Several examples of this funding include the following:

   - $1.2 million from NASA for research on modeling the effects of cosmic radiation on the human brain as part of the NASA Mission to Mars project with potential to unravel the biomechanics of brain damage, potentially benefiting patients with degenerative neurological conditions like Alzheimer's Disease. Please refer to Tab #3 for additional information. (Richard A. Britten, Ph.D.)

   - $326,430 from the Office of Naval Research to provide general support for medical modeling and simulation research efforts. (C. Donald Combs, Ph.D. and Mark W. Scerbo, Ph.D.)

   - $1.338 million from federal grants and private foundations to support work on modeling the protein profiles of breast and prostate cancers and of infections caused by pathogens associated with weapons of mass destruction as well as influenza infections associated with a flu pandemic. (Richard R. Drake, Ph.D.)

- $4.468 million from federal grants, private foundations and other private sources to support work on modeling the early detection of cancer using clinical proteomic techniques for diseases including Adult T-cell leukemia and esophageal cancer. (Oliver J. Semmes, Ph.D.)

- $21,000 from SimQuest, LLC, to evaluate Vision/Haptic interfaces for orthopedic simulators. (Mark W. Scerbo, Ph.D.)

- $2,500 from the Association for Surgical Education (through Carolinas Medical Center, Charlotte, NC) for research in applying automaticity theory to simulator training to enhance operative performance by surgeons. (Mark W. Scerbo, Ph.D.)

- $54,795 from the University of Maryland at Baltimore for the project "Bringing Value through BioSense: A Performance-Based Approach". (Holly D. Gaff, Ph.D.)

- $211,740 from the National Institutes of Health for the project "Spatially-Explicit Mathematical Model of Human Monocytic Ehrlichiosis" to use mathematical modeling to study the dynamics of human monocyte ehrlichiosis, an emerging tick-borne disease. (Holly D. Gaff, Ph.D.)

- $115,000 in subcontracts from MYMIC, LLC, through the Small Business Innovation Research (SBIR) program, for the project "Software to Assess Readiness and Train Medical Support Operations Teams". (Gianluca De Leo, Ph.D., MBA)

- $10,000 from the American Orthopaedic Foot and Ankle Society for the project "Development of a Method to Quantify Subtalar Joint Instability". (Stacie I. Ringleb, Ph.D.)

- $5,000 from the Children's Hospital of The King's Daughters for the project "Instrumentation of a FARO Arm to Measure Load Displacement *in vivo*". (Stacie I. Ringleb, Ph.D.)

- $160,000 from the Computer Science Corporation for the project "Motion Induced Fatigue". (Stacie I. Ringleb, Ph.D.)

- $4,000 Matching Dissertation Award for graduate student Rajesh Paranjape from the International Society of Biomechanics for the dissertation topic "Development and Validation of a Subject Specific Model of the Hindfoot". (Stacie I. Ringleb, Ph.D.)

- $493,000 in attendee registrations, exhibitor fees and sponsorship revenues from the 2007 and 2008 MODSIM World Conference and Exposition events.

In addition to the federal and private funds leveraged as outlined above, additional institutional funds were leveraged in the amount of $248,300 as follows:

- $22,300 from the ODU Office of Research for the project "Instruction + Learning in the Virtual ICU". (Holly D. Gaff, Ph.D.)

- $95,000 from the ODU Office of Research and the ODU Frank Batten College of Engineering and Technology for the project "Modeling and Validation of an Orthotic Knee Brace System for Impact Analysis in High-Speed Boats". (Stacie I. Ringleb, Ph.D.)

- $70,000 from the ODU Office of Research for the project "Virtual Reality in Gait Rehabilitation". (Stacie I. Ringleb, Ph.D.)

- $49,000 in internal ODU departmental graduate research assistant (GRA) financial support for the medical modeling and simulation research program.

- $12,000 in a medical modeling and simulation research stipend from ODU's VMASC.

3) Collaborative efforts in support of private industry.
EVMS and ODU faculty and staff have jointly worked to secure a licensing agreement with Cardionics, Inc., of Webster, TX, to commercialize the Virtual Pathology Stethoscope (VPS) based on technology developed by EVMS and ODU and protected by two patents pending. Please refer to Tab #5 for additional information.

EVMS and ODU faculty and staff jointly worked with MYMIC, LLC, of Portsmouth, VA, and Professional Software Engineering, Inc. (PROSOFT), of Virginia Beach, to develop the Medical Track of the MODSIM World 2007 Conference and Exposition held in September 2007 in Virginia Beach, which drew 630 conference attendees, had 25 exhibitors/sponsors, and raised $248,000 in revenues, all outstanding numbers for an inaugural conference. Please refer to Tab #6 for additional information.

For the MODSIM World 2008 Conference and Exposition, EVMS and ODU helped develop a new conference management entity, the Center for Public-Private Partnerships (CP3), jointly with representatives from private industry, to manage the event going forward. The 2008 conference had approximately 700 attendees, raised revenues of $245,000 and had 38 exhibitors/sponsors, including the Embassy of Canada, which sponsored a trade delegation of 22 Canadian companies at the event. The impressive growth of the conference from 2007 to 2008 occurred despite an increasingly challenging fiscal environment in which other conferences of this same ilk have seen declines in numbers for 2008.

A Medical Modeling and Simulation Cluster group consisting of representatives of academia (e.g., The College of William & Mary, Eastern Virginia Medical School, and Old Dominion University), government (e.g., Hampton Roads Research Partnership, Hampton Roads Economic Development Alliance) and industry (Aegis Technologies, Inc., MYMIC, LLC) has been meeting on a monthly basis with the goal of jointly developing projects that further the medical modeling and simulation industry in Hampton Roads.

EVMS and ODU faculty and staff have worked with Sentara Healthcare to develop modeling and simulation technology for medical applications in the Labor and Delivery environment.

EVMS has entered into a Master Marketing Agreement with Science Applications International Corporation (SAIC), of San Diego, CA, to seek funding for continued research, development, and maturation of known science and technology to discover radiation exposure biomarkers to enable more accurate modeling of human exposure to radiation that will further EVMS as an institution and SAIC as a business. Please refer to Tab #4 for additional information.

EVMS has partnered with the American College of Surgeons, a private, professional organization, to develop the "Medical Modeling and Simulation Database (MMSD)" and an associated website to serve as international resources to further collaboration in the medical modeling and simulation field. The MMSD currently includes information on over 300,000 articles in the medical modeling and simulation field, information on 145 medical modeling and simulation companies, 150 medical modeling and simulation products, 113 medical simulation centers and 43 other simulation websites of possible interest. To date the website has had over 5,000 "hits" from individuals in over 60 countries. Please refer to Tab #7 for additional information.

EVMS partnered with a local private modeling and simulation firm, MYMIC, LLC, based in Portsmouth, to conduct a Regional Medical Modeling and Simulation Program/Study to assess and determine how academia can best help guide further development of the medical modeling and simulation industry in Hampton Roads.

A number of collaborative medical modeling and simulation research proposals have been developed between academia and private industry in Hampton Roads under the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding mechanisms. One such funded SBIR proposal was described in the previous section of this report.

C. Donald Combs, Ph.D., from EVMS, and Mark W. Scerbo, Ph.D., from ODU, closely collaborated with the eastern Virginia Congressional delegation, including Representatives J. Randy Forbes, Robert C. "Bobby" Scott and Thelma Drake, on three federal legislative initiatives that could further the medical modeling and simulation industry in Hampton Roads. Representative Forbes is the founding chairman of the Modeling and Simulation caucus in the House of Representatives, and Representatives Scott and Drake are members of this caucus.

First, Representative Forbes and Representative Patrick Kennedy of Massachusetts introduced The Enhancing SIMULATION (Safety in Medicine Utilizing Leading Advanced Simulation Technologies to Improve Outcomes Now) Act of 2007 (H.R. 4321) as a bipartisan initiative. This legislation would create medical modeling and simulation Centers of Excellence to provide leadership and cutting edge research to advance the field as well as establishing a medical modeling and simulation grant program for academic and professional organizations. While this legislation did not become law, it has had the effect of raising the level of consciousness of members of Congress concerning the medical modeling and simulation field and has created an important linkage in their minds between patient safety and simulation.

The second collaborative outcome was the inclusion in Title VIII, Section 801, of the College Opportunity and Affordability Act of 2008 (H.R. 4137) which amended the Higher Education Act of 1965, of authorization for the Secretary of Education to award competitive grants to institutions of higher education for the enhancement of their existing modeling and simulation programs and to require the Secretary to establish a taskforce within the Department of Education to recommend improvements to the study of modeling and simulation. This bill was signed into law by the President on August 14, 2008.

The third achievement was that in July 2007 the U.S. House of Representatives passed House Resolution 487. This legislation formally declared modeling and simulation a national critical technology that formally honors the contribution of modeling and simulation technology to the national security and prosperity of the United States. The legislation acknowledges the significant impacts of modeling and simulation on a breadth of fields including medicine. This designation lays the groundwork for federal funding of medical modeling and simulation initiatives in the future.

EVMS proteomics scientists Richard R. Drake, Ph.D. and Oliver J. Semmes, Ph.D. closely collaborated in 2007-2008 with Bruker Daltonics, one of the world's leading companies in mass spectroscopy-based research systems. The focus was on technology transfer and cooperation to discover new biomarkers for predictive model-based diagnostic applications using Bruker Daltonics' platforms for clinical proteomics. They also cooperated closely with Bruker Daltonics in the area of LC-MALDI analysis for the identification and quantification of biomarkers in body fluids. This collaboration has been of mutual benefit and the company has continuously provided regular software updates for use in all of their instruments gratis and has provided some laboratory consumables for free or at discounted prices.

4) The number of junior and senior faculty recruited in each field.
At ODU's Virginia Modeling, Analysis and Simulation Center (VMASC), VIMSIM funds facilitated the recruitment of eight (8) new faculty members for medical modeling and simulation related research and the reallocation of research effort of six (6) additional current faculty members and three (3) staff project scientists/engineers to focus on medical modeling and simulation research.

One new ODU faculty member, Stacie I. Ringleb, Ph.D., Assistant Professor of Mechanical Engineering, is a biomedical engineer specializing in biomechanics recruited from the Mayo Clinic to focus on medical modeling and simulation research related to biomechanics at VMASC. A new Endowed Professor of Physical Therapy and Director of the Physical Therapy Program at ODU, Steven Morrison, Ph.D., was recruited from Griffith University in Queensland, Australia to work on medical modeling and simulation and related projects. Poornima Madhavan, Ph.D., Assistant Professor of Psychology, was recruited from the Dynamic Decision-Making Laboratory at Carnegie Mellon University in Pittsburgh. Dr. Madhavan's research is dedicated to the study of human decision-making in simulated environments including the areas of medicine and healthcare. Gianluca De Leo, Ph.D., Assistant Professor of Medical Laboratory and Radiation Sciences, was recruited from the Department of Chemistry at Washington University in St. Louis. Dr. De Leo is a biomedical engineer and has research interests in biomedical

informatics and the use of virtual reality in medicine. Holly D. Gaff, Ph.D., Assistant Professor of Community and Environmental Health, was recruited to ODU from the University of Maryland School of Medicine's Department of Epidemiology and Preventive Medicine. Dr. Gaff's research utilizes mathematical models to determine how fast diseases are spread throughout a community. Mohammed Ferdjallah, Ph.D., Research Assistant Professor in Modeling and Simulation, was recruited from the University of Tennessee-Knoxville. Dr. Ferdjallah holds a Ph.D. in Electrical and Computer Engineering and an M.S. degree in Biomedical Engineering from the University of Texas at Austin and has completed post-doctoral work at the Medical College of Wisconsin. Dr. Ferdjallah's research interests include computational modeling of biophysical phenomena, muscle fatigue and human motion. Rani A. Kady, Ph.D., Assistant Professor of Engineering Management and Systems Engineering, received his Ph.D. in industrial and systems engineering, with a focus on safety and ergonomics, from Auburn University. Dr. Kady's primary research interest focuses on the application of human performance, modeling and optimization techniques to emergency evacuations, including hospitals and nursing homes. Dr. Kady's research will be especially relevant in an area like Hampton Roads that is vulnerable to hurricanes. Jiang Li, Ph.D., Assistant Professor of Electrical and Computer Engineering, joined ODU from the National Institutes of Health, where he was a postdoctoral fellow in the department of radiology. Dr. Li's research interests include machine learning, computer-aided medical diagnosis systems, medical signal/image processing, the neural network and medical modeling and simulation.

Six (6) current faculty members affiliated with the Virginia Modeling, Analysis and Simulation Center (VMASC) at ODU reallocated their research efforts to perform research related to medical modeling and simulation. These faculty are as follows: Mark W. Scerbo, Ph.D., Professor of Psychology; Lee A. Belfore, II, Ph.D., Associate Professor of Electrical and Computer Engineering; Frederick D. McKenzie, Ph.D., Associate Professor of Electrical and Computer Engineering; Yuzhong Shen, Ph.D., Assistant Professor of Electrical and Computer Engineering; James P. Bliss, Ph.D., Associate Professor of Psychology, and Jessica R. Crouch, Ph.D., Assistant Professor of Computer Science.

Among the ODU VMASC staff included in the VIMSIM Initiative are Hector M. Garcia, M.Arch., and Jennifer A. Seevinck, M.A.E.A., who serve as Project Scientists for medical modeling and simulation, and Menion Croll, who serves as a Software Engineer.

At EVMS, VIMSIM funds facilitated the reallocation of effort of eleven faculty and several staff members to focus on medical modeling and simulation.

The eleven (11) EVMS faculty included in the VIMSIM Initiative are Thomas W. Hubbard, M.D., M.P.H., J.D., Professor of Clinical Pediatrics; Richard R. Drake, Ph.D., Professor of Microbiology and Molecular Cell Biology; O. John Semmes, Ph.D., Professor of Microbiology and Molecular Cell Biology; Leonard J. Weireter, Jr., M.D., Professor of Surgery; C. Donald Combs, Ph.D., Professor of Health Professions and Vice Provost for Planning and Health Professions; Gayatri Kapur, M.D., Assistant Professor of Obstetrics and Gynecology; Stephen S. Davis, M.D., Assistant Professor of Obstetrics and Gynecology; Adair R. Heyl, Ph.D., Assistant Professor of Obstetrics and Gynecology; John A. Ullian, Ph.D., Associate Professor of Family and Community Medicine; Gavin W. Welch, Ph.D., Assistant Professor of

Health Professions and Richard A. Britten, Ph.D., Associate Professor of Radiation Oncology and Biophysics.

Among the EVMS staff members included in the VIMSIM Initiative are Gayle A. Gliva-McConvey, Director of the Theresa A. Thomas Professional Skills Teaching and Assessment Center, Robert J. Alpino who serves as a part-time grant writer, Richard L. DiPeppe who is responsible for the Medical Modeling and Simulation Database, and research support staff including Meenal K. Walia, who serves as a research assistant.

5) <u>The amount of federal or other private grant funds received as the result of those recruitments.</u>
$560,535 of the total of $8,409,465 in federal and private grant funds generated in the 2006-2008 biennium were received as a result of the new faculty recruitments funded by the VIMSIM medical modeling and simulation research capacity funding. In addition, $187,300 in institutional funds was reallocated to the research portfolio of the newly recruited faculty. The balance of the funds was attributable to the reallocation of current faculty effort to medical modeling and simulation research.

6) <u>Additional grants or contracts being pursued.</u>
Among the additional grants or contracts being pursued by medical modeling and simulation researchers funded by VIMSIM funding are the following:
- Department of Defense (DoD) Congressionally Directed Medical Research Program proposal for "Imaging Mass Spectroscopy for Improved Prostate Cancer Diagnostics".
- National Cancer Institute (NCI) Innovative Solutions to Cancer Sample Preparation research program proposal "Proximal Prostate Fluids for Protein and miRNA Biomarkers"
- National Institutes of Health (NIH) National Institute of Biomedical Imaging and Bioengineering (NIBIB), Small Business Innovation Research (SBIR) funding and NIH National Institute for Arthritis and Musculoskeletal and Skin Diseases (NIAMS) funding
- National Science Foundation International Education and Research Grant
- Sentara Healthcare
- Augmented Reality and Complex Environment Training System for Medical Training (ARCETS-Med)
- Craniotomy Burr Hole Simulator Training Simulation from SimQuest, LLC
- SBIR (Small Business Innovation Research) proposal was submitted to the National Institutes of Health to further develop the virtual reality rehabilitation system for patients with a gait impairment due to a stroke.
- SBIR proposal was submitted with A2-T2, a Florida-based small business, for an internet based rehabilitation program for injured warriors.

7) <u>The level of instructional activity conducted by these faculty.</u>
Of the eight (8) new VMASC affiliated faculty members with a medical focus, two (2) were employed in the 2006-07 academic year with the remaining six (6) beginning their duties in the 2007-08 academic year. Each of the 2006-2007 year

hires taught one class in their home department and taught one class in the medical modeling and simulation program in the 2007-08 academic year.

The first research faculty member hired at VMASC in 2006-2007 to focus on medical modeling and simulation (Stacie I. Ringleb, Ph.D., recruited from the Mayo Clinic) taught the course MSIM 695 Special Topics in Modeling and Simulation: Modeling in Musculoskeletal Biomechanics, in Spring 2007. The second, Holly D. Gaff, Ph.D., taught the class HLSC 795 Topics: Modeling and Simulation in Health Sciences.

C. Donald Combs, Ph.D., from EVMS, and Frederick D. McKenzie, Ph.D., from ODU, jointly developed the new course Electrical and Computer Engineering (ECE) 495/595/695 "Topics in Medical Imaging and Simulation" and have jointly taught the course during the summers of 2006 through 2008. Thomas W. Hubbard, M.D., M.P.H., J.D., Professor of Clinical Pediatrics at EVMS, also participated in the course as a guest lecturer on standardized (simulated) patients. Dr. McKenzie has now formally incorporated this course into the regular semester-based schedule as ECE 462/562 and MSIM 562.

C. Donald Combs, Ph.D., from EVMS, presented "The Emerging Importance of Using Medical Simulation in Resident Education" as part of the EVMS Faculty Development Grand Rounds "Improving Your Teaching" series on April 19, 2007. The presentation was simulcast over the Eastern Virginia Telemedicine Network to the Veterans Affairs Medical Center in Hampton, VA as well as to other EVTN network sites.

Mark W. Scerbo, Ph.D., from ODU, developed a new course called Medical Simulation (Psych 896) that was offered in the 2007-2008 spring semester. Richard DiPeppe of EVMS participated as a guest lecturer in the course introducing the students to the Medical Modeling and Simulation Database.

Yuzhong Shen, Ph.D., from ODU, taught two courses in Visualization in 2007-2008, one at the graduate level (MSIM 641) and one at the undergraduate level (ECE 406).

EVMS, as part of its preparation for reaffirmation of its accreditation by the Southern Association of Colleges and Schools (SACS), has developed a Quality Enhancement Plan (QEP) to improve some aspects of the student learning environment at EVMS. "EVMS 2.0" is the school's plan to enhance student learning by improving the effectiveness of the instructional technology utilized in the student educational process and by incorporating modeling and simulation in the undergraduate medical education curriculum. This will have the effect of increasing the level of effort of instructional activity related to modeling and simulation by EVMS faculty supported by the VIMSIM funding.

In addition to the direct instructional activity listed above, Dr. Combs and the other faculty supported by the VIMSIM initiative published numerous scholarly papers during the biennium and conducted presentations at key conferences in the field such as the Medicine Meets Virtual Reality conference, the Society for Simulation in Healthcare conference and the IPSI conferences. A select list of faculty scholarly activities in medical modeling and simulation has been attached behind Tab #8.

8) The impact of research activities on undergraduate instruction.
One ODU undergraduate student and one undergraduate from Spelman College are working on medical modeling and simulation research through the ODU Department of Psychology.

9) The use of graduate student aid funds.
Nine (9) ODU doctoral level graduate students in the fields of Psychology, Electrical and Computer Engineering, Modeling and Simulation and Mechanical Engineering have been supported during the biennium by ODU on medical modeling and simulation research projects with the graduate student aid funds along with seven (7) master's level students in the fields of Electrical and Computer Engineering, Nursing Anesthesia and Mechanical Engineering. Three EVMS Master of Public Health students (Renee Scott Walker, Tony Barkey and Bettina Velena) were employed as Research Assistants in medical modeling and simulation research with the funds. Three doctoral students (Hope A. Hanner-Bailey (Psychology), Melissa L. Mannion (Medicine) and Elizabeth A. Schmidt (Psychology)) were supported by EVMS funds.

10) Recommendations for future investment.
We have identified four core areas of medical modeling and simulation activities being conducted in the Hampton Roads area: 1) modeling and simulation for education and training to improve patient safety and the quality of healthcare, 2) modeling and simulation for treatment, 3) modeling and simulation for disease modeling, and, 4) modeling and simulation for hospital management and homeland security issues involving health care. The current funding is supporting the use of modeling and simulation for education and training. We would like to see additional funds invested to support the other three areas of medical modeling and simulation. In line with these investments, funds should be identified to help generate pilot data to support additional funding, to increase our number of research support staff, including both technical support staff (2-3 per area) as well as a dedicated grant writer to help with preparation of research proposals.

On the training side, we would like to see an investment of funds in high-tech medical simulator systems that can be integrated into our virtual environments. The investment should include any resources necessary to allow researchers to gain effective access to simulator proprietary interfaces and data formats. Please refer to the Virtual Operating Room information provided behind Tab #9.

Additional potential areas for Augmented Standardized Patient research include augmented ophthalmology, otology, and sonography.

Future investment should be made in developing high-fidelity training experiences that show measureable improvements over traditional educational modalities. The investment should be divided into three areas including the development of high-fidelity simulators which provide realistic experiences for the trainees, support for task analysis and human factors performance studies of health care practitioners and support for developing a prototype training exercise.

The final area of future investment is to invest in additional medical course development.

In the area of capital investment, the MERIT (Medical Education and Research in Translation) Project at EVMS which was partially funded by the Commonwealth in the 2008 higher education bond issue, supports the mission and strategic direction of the medical school in a variety of ways, one of which is medical modeling and simulation. MERIT will substantially expand and improve the space available for the education and research programs at EVMS. Specifically, MERIT involves the construction of a new, 105,000 square foot building at EVMS that will house the biomedical research programs in a state-of-the-art facility and consolidates the educational support programs onto the main campus. A major component of MERIT will be the development of a regional state-of-the-art medical modeling and simulation training center that will be utilized by first responders through medical residents and fellows for hands-on medical modeling and simulation training. Please refer to information on the potential economic impact of modeling and simulation located behind Tab #10.

About EVMS

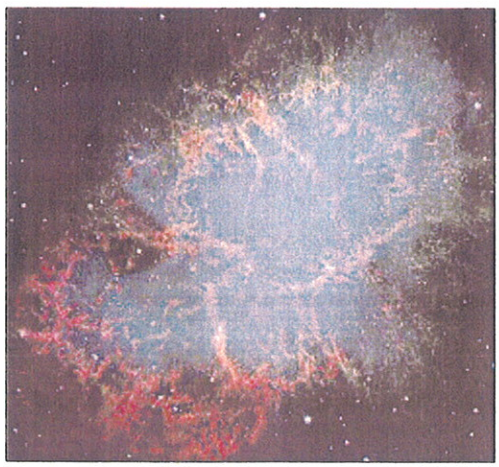
Contact Us
Quick Facts
About Hampton Roads
Calendars and Events
Centers of Excellence
Driving Directions
History
Map of Eastern Virginia Medical Center PDF
EVMS News
Administration
Teaching Hospitals
Departments
Directory
Human Resources
EVMS Mission Statement
Privacy Policy

Mars Mission Risk 29: Scientists Research Ways to Reduce Radiation-Induced Brain Damage

Research could lead to new treatments for conditions like Alzheimer's disease

September 27, 2006

NORFOLK—Among the gravest risks of a manned flight to Mars ranks the possibility that massive amounts of solar and cosmic radiation will decimate the brains of astronauts, leaving them in a vegetative state, if they survive at all.



Supernova explosions like this one accelerate atomic nuclei to nearly light speed. The resulting "cosmic rays" pose a potential hazard to astronauts. *Photo courtesy Science@NASA*.

Dubbed "Risk 29" by NASA's Mars scientists, the cosmic radiation risk remains a show-stopper because shielding a spacecraft from all radiation could make it too heavy to reach Mars, which, at its closest, is 38 million miles from Earth.

Now, medical scientists at EVMS have been tasked with determining the human brain's maximum safe cosmic radiation dose and to decipher precisely how radiation causes cognitive impairment — part of a quest for biological countermeasures to reduce radiation-related cognitive impairment.

The NASA-funded $1.2 million research project could not only help eliminate the risks to astronauts, but it could unravel the biomechanics of brain damage, potentially benefiting patients with degenerative neurological conditions like Alzheimer's disease.

"This research may not only help make it safer to go to Mars, it could lead us to a deeper understanding of how the brain functions," said principal investigator Richard A. Britten, Ph.D., associate professor of radiation oncology and biophysics. "That eventually could help patients dealing with conditions that cause dementia."

The idea of a manned mission to Mars has captured the imagination for decades. But flying to Mars, even without humans aboard, is a monumentally risky feat. Since 1998, the United States has completed seven Mars missions. Four of those failed when the Mars landers were lost on arrival.

As part of a new push to put a man on Mars, NASA has sketched out a roadmap laying out 45 risks to astronauts on a two-year space mission. Risk 29 addresses the fact that Mars astronauts will be bombarded by high-energy cosmic radiation — shielded on Earth by the atmosphere and the Van Allen Radiation Belts — that few medical scientists have studied.

"These are very obscure kinds of radiation that on Earth we would only see in the event of a nuclear disaster," said Britten.

While many assume that open space between planets is empty, it's not, Britten notes. The dark realm between planets teems with cosmic particles generated by solar flares, supernovas and astronomical cataclysms dating to the Big Bang, particles that can pass through metal and human tissues, often with enough energy to shred DNA. To make matters more complex, one possible trajectory involves flying around Venus and using its gravitational pull to sling the spacecraft toward Mars. That means flying closer to the sun, the source of powerful solar radiation.

"The sun is basically a big nuclear reactor," Britten said.

The scientists hope to determine how much shielding the spacecrafts and astronauts will need, and also develop other countermeasures that help to reduce radiation-induced brain damage.

The EVMS team consists of Britten; Larry Sanford, Ph.D., professor of pathology and anatomy; Gyorgy Lonart, Ph.D., associate professor of pathology and anatomy; Sylvia J. Singletary, D.V.M., department of physiological sciences; and Richard R. Drake, Ph.D., associate professor of microbiology and molecular cell biology.

To help determine the brain's maximum acceptable dose of solar and cosmic radiation, Britten's team must replicate the type of radiation astronauts will be exposed to in deep space. They then must calculate how much damage is caused by particles with various energy levels.

"There are only a handful of laboratories in the world where these kinds of high-energy particles can be produced," Britten said. His team will work closely with scientists at Brookhaven National Laboratory in New York.

As part of his $1.2-million segment of the study, the EVMS team will measure physical and behavioral changes in rats exposed to various levels of the type of radiation that Mars astronauts will encounter in space. They will also conduct proteomic analysis of portions of the irradiated brains to obtain more precise details about the biochemical

changes.

To date, many scientists have suggested that reduced cognitive impairment results solely from the death of the brain's neurons. Britten believes other, more complex mechanisms are at work, processes that could be manipulated by NASA's medical staff.

In a very rudimentary sense, the brain can be likened to photo paper. Chemicals allow the photo paper to "fix" the images – in this case, the "images" can be visual, aural, tactile, sonic, emotional or intellectual, often connected. If the chemical stew gets out of whack, the images, dubbed engrams, don't stick or become cloudy and indistinct.

"Once we understand what's not working, then maybe we can fix it," said Britten.

Because radiation damage is similar to the free-radical injury resulting from aging and certain neurological diseases, the research could lead to better treatments for conditions like Alzheimer's disease that cause progressive dementia.

Top

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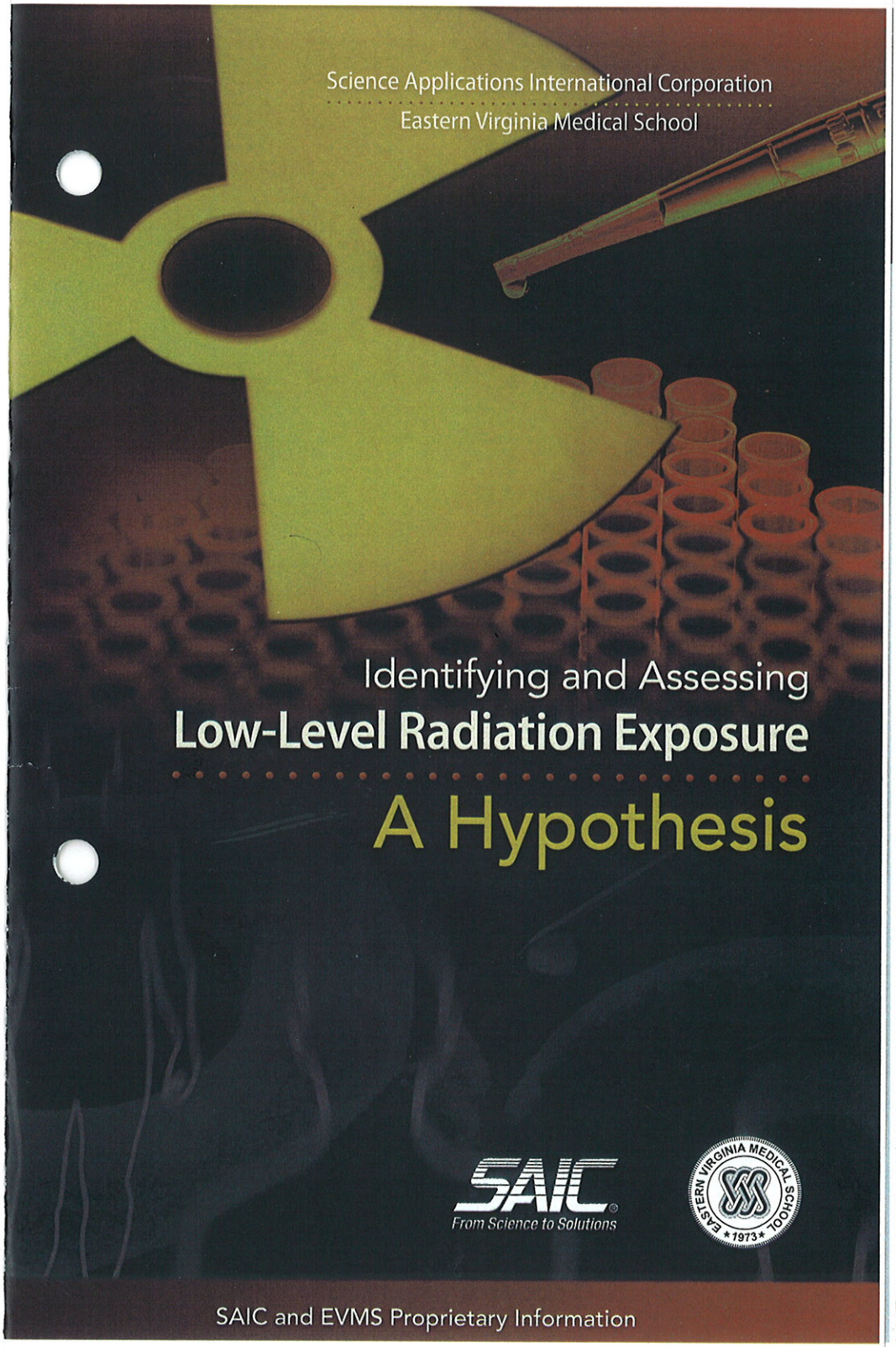

Science Applications International Corporation
Eastern Virginia Medical School

Identifying and Assessing Low-Level Radiation Exposure

A Hypothesis

SAIC
From Science to Solutions

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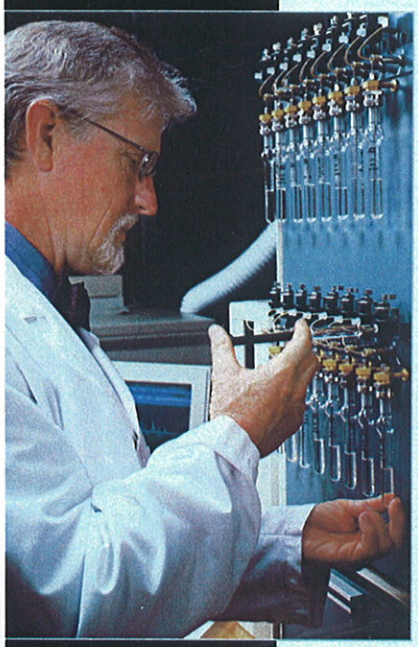
the challenge

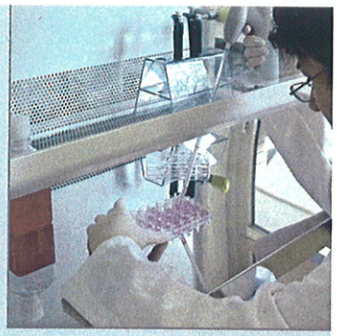


Assess Radiation Exposure

How can we assess a person's previous exposure to radiation, especially if they have never been monitored or tested?

Whether for military or medical use; for homeland security, the intelligence community, or the energy industry; or for space exploration, public safety or public health ....

Our nation needs reliable ways to assess radiation exposure. We believe we can develop practical tests for radiation exposure through further basic research.



testing the hypothesis

Testing the hypothesis is an intensive problem.

The human body contains hundreds of thousands of different proteins. Analyzing the patterns formed by the levels of large numbers of proteins is incredibly complex, but the EVMS-SAIC team has made significant progress in our research.

We have studied the serum proteome of rats that received in vivo exposure to graded doses of X-rays, and we have identified certain proteins in their sera whose expression is altered in a dose-dependent manner.

We intend to:

- Insert a permanent venous port into the exterior jugular vein of adult rats before exposing them to radiation and take serial blood samples from irradiated (0 – 13 Gray) animals at early (one, two, three and seven days post-exposure) and late (three, six, and nine months post-exposure). We will look specifically for peptide peaks whose expression varies with physical dose. We will sequence candidate peptides, identify the protein and verify it by Western blot analysis.
- Build computational algorithms to recognize protein combinations or patterns indicative of radiation exposure.
- Identify relationships among doses, patterns of protein expression and biological consequences.
- Develop models and simulations to test this hypothesis.

We expect a pattern.

We expect to be able to identify a pattern of protein expression that correlates to dose and time of exposure.

final outcome – when hypothesis is proven

Preliminary findings already support our hypothesis.

Certain proteins may act as biodosimeters: their expression correlates with dose at early and late time points following exposure.

A Mini-Experiment: Changes After Exposure

Under the auspices of a government agency-funded study, we have used Matrix-Assisted Laser Desorption Ionization (MALDI) Time-of-Flight (TOF)/TOF™ mass spectrometry to study the serum proteome of rats that have received cranial radiation. Serum proteins were absorbed on weak cation exchange (WCX) affinity beads, digested in situ, and subjected to MALDI-TOF/TOF™ analysis. Preliminary data from the first 30 rats suggest that serum proteins exist that are differentially expressed seven days following cranial radiation. Moreover, we have identified proteins whose expression is differentially expressed in a dose-dependent manner (four versus eight Gray or four versus 13 Gray).

We hypothesize that even more serum protein changes will occur following whole-body exposures. We seek to use the same experimental approach to conduct a detailed study of serum proteome changes that arise from whole-body radiation exposures.

MALDI-TOF/TOF is a registered trademark of PerSeptive Biosystems, Inc., in the United States and other countries.

the reliable alternative — biomarkers

Biomarkers that can be detected through simple blood tests may be the answer to assessing ionizing radiation exposure.

Biomarker—n., a trait (in this case, a protein) in a cell that, by its presence, indicates exposure to environmental substances.

Biomarkers are used widely to detect the presence of many diseases, such as cancer. However, no known biomarkers indicate a person's exposure to radiation.

We have observed through research that certain protein biomarkers may be reliable indicators of radiation exposure.

We believe that our team can develop practical tests for radiation exposure through further proteomic research.

We assert that a correct combination of biomarkers may be found that can reliably detect the radiation dose to which a person has been exposed, and it may even indicate when the exposure occurred.

Our preliminary in vivo research found serum proteome changes within days of exposure, and in some cases, these changes persisted for at least 90 days. Based on this research, we believe our hypothesis is plausible.

SAIC and EVMS are teaming to test this hypothesis, and, if it is found to be accurate, to create the tools, techniques and processes needed to develop reliable proteomic radiation biomarkers that can be used in simple blood tests. Our goal is to identify patterns of protein levels that will reflect the amount of radiation exposure and elapsed time since exposure.

Proteomics is the study of the structures and functions of proteins.

new Science, new Hypothesis, new Potential Solution

hypothesis:

presence of certain proteins indicates exposure

Hypothesis	After exposure to radiation, biologic material will contain not only unique proteins, but also unique, dose-dependent amounts of proteins.
Corollary	If we can relate the presence and level of a given protein to a specific level of radiation exposure, we can look for that protein in the tissue or blood sample.
Fact	Our preliminary studies have shown that in vivo x-ray exposure of rats results in changes in the expression of certain proteins in their blood.

Expression is the measurement of the presence and abundance of a protein in a particular cell or tissue

If	***We can identify statistically significant changes in protein concentrations that correlate with the dose and time of radiation exposure.***
Then	***We will have a powerful diagnostic tool.***
Real-World Implications	We may be able to determine the level of the dose and, possibly, when the exposure occurred.

Skills, expertise, team

The problem is intense — technologically intense, procedurally intense, and computationally intense. However, we believe we are focused on the right hypothesis with the right team to tackle this problem adequately. Our team combines expertise in health physics, radiobiology, microbiology and molecular cell biology, bioinformatics, and computational biology.

Our approach is unique. A military research institute and other research facilities have shown the value of using serum protein profiling as biodosimeters, but their studies used on pre-selected "candidate" response proteins. Our approach is an unbiased, pan-proteomic screening that allows nature to inform us of the processes altered after radiation exposure, rather than forcing us to assume what will occur. Our approach takes advantage of recent advances in biological data acquisition and the analysis of high-dimensional data sets.

We have qualified experts, a tailored laboratory setup, the necessary equipment, and the appropriate systems.

- **EVMS** is a leading researcher in the emerging fields of proteomic and protein biomarkers, with knowledge of the proteome and its complex protein-to-protein interactions, as well as a leader in medical modeling and simulation.
- **SAIC** is a leading provider of scientific, engineering, systems integration, and technical services and solutions. We solve complex technical challenges requiring innovative solutions for customers' mission-critical functions, and we have a strong legacy of nuclear research, including reconstructing radiation doses that affected veterans who participated in nuclear weapons testing programs.

The ability to assess radiation exposure with a simple blood test will give the nation a valuable new tool to help improve public health, public safety, military strength and national security.

The signs point to success. Join us to transform this hypothesis into reality.

REALITY in Virginia's Hampton Roads

Hearing is believing.

VPS - The Virtual Pathology Stethoscope

Created by a team of researchers from Old Dominion University's Virginia Center for Modeling and Simulation and Eastern Virginia Medical School, the VPS simulates sounds of the circulatory and respiratory systems to help medical students recognize the telltale sounds of sickness.

Virginia's Hampton Roads - There's nothing standard about our technology

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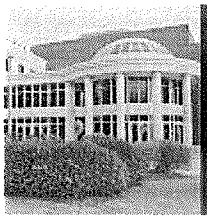
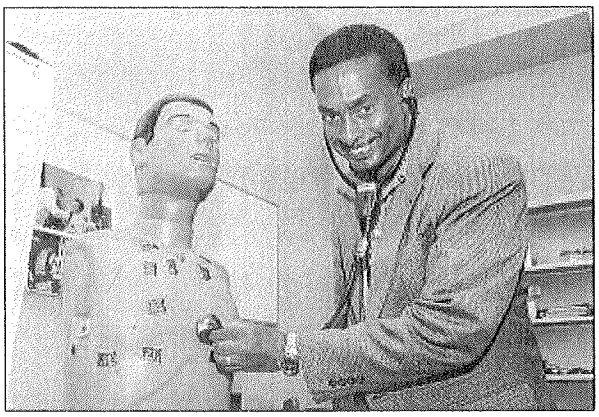


About EVMS
Contact Us
Quick Facts
About Hampton Roads
Calendars and Events
Centers of Excellence
Driving Directions
History
Map of Eastern Virginia Medical Center PDF
EVMS News
Administration
Teaching Hospitals
Departments
Directory
Human Resources
EVMS Mission Statement
Privacy Policy

EVMS/ODU license virtual stethoscope to Texas manufacturer

August 24, 2007

NORFOLK—A Virtual Pathology Stethoscope invented by a team of researchers from Eastern Virginia Medical School (EVMS) and Old Dominion University's Virginia Modeling, Analysis and Simulation Center (VMASC) has been licensed to a Texas-based company, Cardionics Inc., which manufactures medical diagnostic and teaching equipment.



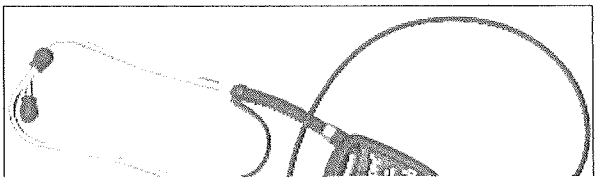
Rick McKenzie, associate professor of electrical and computer engineering at ODU, demonstrates a mock-up of the virtual stethoscope.

The Virtual Pathology Stethoscope, or VPS, is a training device that can simulate the sounds of a human body's circulatory and respiratory systems. It will be an important addition to the products offered by Cardionics, according to Keith Johnson, president of the company. Cardionics specializes in technologies related to auscultation, which is the art of listening for sounds made by the body's internal organs. Its current products include an E-Scope Electronic Stethoscope and a Pocket Monitor Analysis System that have helped to revolutionize bedside diagnoses.

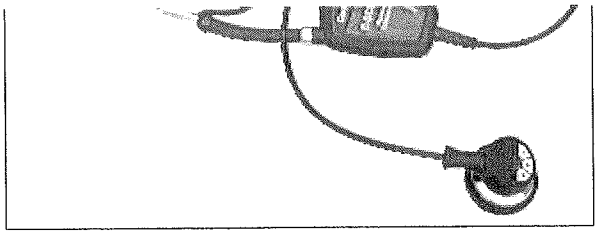
The invention is the first licensed product to emerge from the National Center for Collaboration in Medical Modeling and Simulation, which is a joint venture of EVMS and Old Dominion University.

Thomas W. Hubbard, M.D., professor of pediatrics and director of the EVMS Office of Professional Development, leads the team of inventors. His top collaborator at VMASC is Frederic McKenzie, an ODU associate professor of electrical and computer engineering.

The VPS is designed to be used in tandem with a standardized patient (SP). Medical schools increasingly train



doctors-to-be by using SPs, who are actors skilled at pretending to be sick. Working with SPs, medical students improve their interviewing skills and gain the medical judgment they need to diagnose ailments.



The Virtual Pathology Stethoscope will look much like this current product of Texas manufacturer Cardionics.

But when a medical student puts a conventional stethoscope to the body of the SP, the typically healthy sounds heard don't match the illness the SP is portraying. The VPS substitutes abnormal sounds for healthy sounds, so that when the student puts the augmented stethoscope to the SP's body, the sounds provide evidence that can support the diagnosis. The sounds the teaching stethoscope plays are recorded from actual patients who have a variety of diseases.

Members of the VPS development team took the device and a veteran EVMS standardized patient, Patrick Walker, to the 4th annual Advanced Initiatives in Medical Simulations (AIMS) Conference and Congressional Exhibition in May in Washington, D.C. The invention drew the attention of numerous conference goers, including Virginia 4th District Rep. Randy Forbes and Rep. Patrick Kennedy of Rhode Island, the son of Massachusetts Sen. Edward Kennedy and a champion of health care issues in Congress.

Both Kennedy and Forbes took time to test the stethoscope on Walker. When they listened at his neck, they heard the whooshing sound of plaque-restricted blood flow through the carotid artery. When they listened to his chest, they heard crackling sounds in the lungs, a sign of pneumonia or congestive heart failure.

ODU and EVMS joined forces in 2001 to form the National Center for Collaboration in Medical Modeling and Simulation, which has attracted funding from several sources across the nation, including the Stemmler Medical Research Fund of the National Board of Medicine, as well as national media attention.

"The VPS is one example of the potential of medical simulation to improve the training of medical and health professionals and, ultimately, to improve patient safety," said C. Donald Combs, Ph.D., who leads the medical modeling initiative at EVMS. Combs and Mark Scerbo, professor of human factors psychology at ODU, are co-directors of the National Center for Collaboration in Medical Modeling and Simulation.

An article late last year in *Mechanical Engineering* magazine focused on one of the products of the collaboration — a virtual operating room. This immensely complicated system, which can be used to train surgeons and other operating room personnel, utilizes ODU's Cave Automatic Virtual Environment (CAVE). Combs said these simulations and others under development are the early returns on the

investments that the federal and state governments have made in the region's effort to expand simulation research and development beyond the military market into areas such as medical modeling and emergency response.

A primary mission of VMASC is to create modeling, simulation and visualization applications that are practical enough for commercial development. When representatives from the EVMS Theresa A. Thomas Center Professionals Skills Teaching and Assessment Center sought a way to enhance student training with SPs, they asked VMASC to create the VPS.

McKenzie, the VMASC researcher, said the team's original VPS is very high-tech, but too expensive for broad use. This first system is called "tracked VPS" because it includes a sensing component that tracks on the body where the stethoscope's head is placed so the appropriate sound recording can be cued. The team has a patent pending for the "tracked VPS," but then moved on to improve the system's practicality.

The more economical version, which is the one licensed to Cardionics, is "SP-triggered VPS," for which another patent is pending. This is the system that was demonstrated at the AIMS conference, and for it the SP uses hidden controls to track the stethoscope's head and to tell the system what sounds should be played. The second system is more economical because it does not have the automatic tracking component.

Preliminary tests with EVMS students have been promising. One series of tests reported in a paper written by McKenzie, Hubbard and other colleagues showed that the augmented standardized patient system is "a reliable and valid assessment tool."

The project team also includes John Ullian, Gayle Gliva-McConvey and Robert Alpino of EVMS, and Hector Garcia, Reynel Castelino and Bo Sun from ODU/VMASC.

Top

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Printer Version Of Inside
Business - Hampton
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INSIDER NEWS

EVMS-ODU team licenses first invention

Virtual stethoscope heads to Texas company

ERICK SORICELLI
Monday August 27, 2007

A team of medical modeling and simulation researchers from Eastern Virginia Medical School and Old Dominion University announced last week that they had licensed their first invention, a virtual stethoscope, to Cardionics Inc., a Webster, Texas, medical manufacturer.

The Virtual Pathology Stethoscope, or VPS, is an invention from the National Center for Collaboration in Medical Modeling and Simulation, a joint venture of EVMS and ODU. The VPS is a training device used to simulate the sounds of a human body's circulatory and respiratory systems. The device joins others in Cardionics' product line used for auscultation, or listening to the sounds made by the body's internal organs.

Cardionics president Keith Johnson said the company expects to start selling the VPS by next year.

The device's ideal use is on standardized patients, or actors who pretend to be sick. Medical school students work with the actors to learn interviewing and patient diagnostic skills.

EVMS uses SPs through its Professional Skills Teaching and Assessment Center. Staff from that center approached researchers at ODU three years ago about enhancing student training, which is how the VPS was first conceived.

"This program uses trained actors to simulate 600-650 different conditions," said Donald Combs, EVMS' associate dean for planning and health professions, and a co-director of the National Center. "We've started with some fairly common medical conditions. Any sort of heart or lung disease that could be picked up by sound can be simulated."

The VPS licensed to Cardionics allows an SP to use hidden controls to track the stethoscope's head and tell the system what sounds should be played. This allows a perfectly healthy person, acting as an SP, to simulate a heart or lung condition.

The "SP-triggered VPS" is a variation of the original invention, which was deemed too expensive for commercial use. The original, a "tracked VPS," had a sensor that tracked on the body where a stethoscope head was placed, in order for the right sound to play.

Cardionics has a number of electronic stethoscopes in its product line. It also sells instructional CD-ROMs, medical manikins and other sound simulators.

The company's stethoscopes sell in the hundreds of dollars, but Johnson, of Cardionics, said the VPS will likely sell for more than that. A price hasn't been determined.

"This differs a little bit from anything else we have," Johnson said.

The National Center was established in 2001. Its primary focus is on creating medical mod-sim products that are suitable for commercial use. The center is one of several partnerships between EVMS and ODU.

Earlier this month, EVMS and ODU signed an agreement that establishes a four-person executive committee to oversee existing partnerships and develop new ones. EVMS provost Gerald Pepe and ODU provost Thomas Isenhour are on the committee. Pepe and Isenhour will choose the remaining two members from each school.

OLD DOMINION UNIVERSITY NEWS

RESEARCHERS FROM ODU AND EVMS SHOWCASE NEW MEDICAL TOOL

A team of modeling and simulation researchers from Old Dominion University and Eastern Virginia Medical School made a big impression with a simple concept at the 4th annual Advanced Initiatives in Medical Simulations (AIMS) Conference and Congressional Exhibition May 8-9 in Washington, D.C.

The new tool that the team exhibited is a stethoscope, but a very smart "virtual pathology stethoscope" the researchers call the VPS. It can simulate sounds of the circulatory and respiratory systems to help medical students recognize the telltale sounds of sickness.

"Our demonstration was definitely the hit of the various displays," said Rick McKenzie, associate professor of electrical and computer engineering and a researcher at ODU's Virginia Modeling, Analysis and Simulation Center (VMASC). McKenzie is heading up the "augmented reality" stethoscope project together with Dr. Thomas Hubbard of EVMS's Theresa A. Thomas Professional Skills Teaching and Assessment Center.

Rep. Patrick Kennedy of Rhode Island, the son of Massachusetts Sen. Edward Kennedy and a champion of health care issues in Congress, spent an extra measure of time at the VMASC-EVMS demonstration and had good words for the project when he addressed the full AIMS conference, according to McKenzie.

"There were several people who wanted to buy the technology immediately," added Mark Scerbo, professor of human factors psychology at ODU and a collaborator in medical modeling with researchers at VMASC.

Medical schools for decades have trained doctors-to-be by using what is known as a standardized patient (SP). This is an actor skilled at pretending to be sick. The SP is able to report symptoms of a particular ailment. In working with SPs, medical students improve their interviewing skills and gain the medical judgment they need to diagnose ailments.

"Trouble is, when you put the stethoscope to the standardized patient, you find that he is healthy," Scerbo said. "Our augmented stethoscope simply substitutes pathological sounds for healthy sounds."

In other words, the SP reports and portrays symptoms of a particular ailment and when the medical student puts the augmented stethoscope to the SP's body, the

Preliminary tests with students at EVMS have been promising, McKenzie said. One series of tests reported in a paper written by McKenzie, Hubbard and other colleagues showed that the augmented standardized patient system is "statistically significant in providing a valid assessment tool."

The project team also includes John Ullian and Gayle Gliva-McConvey of EVMS and Hector Garcia, visualization lab manager for VMASC.

AIMS is a coalition of individuals and organizations committed to promoting medical simulation as a way to improve patient safety, reduce medical errors and lower health care costs.

This article was posted on: May 14, 2007

Return to News of the Week

Published on HamptonRoads.com | PilotOnline.com (http://hamptonroads.com)

Need to practice surgery? Flying? Modsim may help

By Kathy Adams

VIRGINIA BEACH

It's like the game Operation, but without the blinking red nose.

New technology employing lifelike manikins and computer simulators is allowing medical students to get hands-on experience without risking real patients. Students can practice surgeries, everyday procedures, medical exams, teamwork and even delivering bad news to a family, said Dr. William Dunn, director of the Mayo Clinic Multidisciplinary Simulation Center in Rochester, Minn. Dunn spoke Tuesday during the Mod Sim World 2008 conference at the Virginia Beach Convention Center.

The Mayo Clinic employs modeling and simulation - the use of physical or virtual models to simulate real-life scenarios under a variety of conditions - to train medical students. H ealth care is just one field embracing the technology.

Modeling and simulation helps NASA train pilots, the military plan wartime strategy, Disney build rides and departments of transportation lay out roads. Shipbuilders, railroads, schools and city planners use it, too.

The second annual Mod Sim World conference this week is bringing together nearly 700 people from these fields to share information. The conference continues through Thursday with exhibits, speakers and workshops on topics from health and medicine to defense and homeland security.

"Reality's too fast or too slow, too big or too small, too safe or too dangerous," said Robert Sharak, the conference's director of sponsors and exhibits.

But models can simulate reality without the risk and facilitate decision-making, said Paul Fosdick, program chair for the conference and Northrop Grumman's technical director for modeling and simulation in Hampton Roads.

"We're trying to create a model of the real world so that we're able to explore with it, train with the technology, without introducing a large amount of resources," Fosdick said.

With more than 100 local companies specializing in modeling and simulation, the industry brings more than $360 million each year to Hampton Roads, said Mike McGinnis, executive director of Old Dominion University's Virginia Modeling, Analysis and Simulation Center. Both ODU and Tidewater Community College offer specialized modeling and simulation programs.

The industry's growing, as more businesses and government agencies use the technology to answer questions such as: How will my supply chain work? What happens if an anthrax attack hits a major

U.S. city?

Modeling and simulation can help decision-makers prepare for multiple scenarios.

It also can save lives, Dunn said. Medical students trained using modeling and simulation tools have better clinical outcomes, less anxiety and improved confidence, resulting in fewer mistakes, he said.

"The tools of simulation can help raise the bar of 100,000 or so preventable medical errors that end in death," Dunn said. "As opposed to all the other methods of passive learning, experience matters."

Kathy Adams, (757) 446-2583, kathy.adams@pilotonline.com

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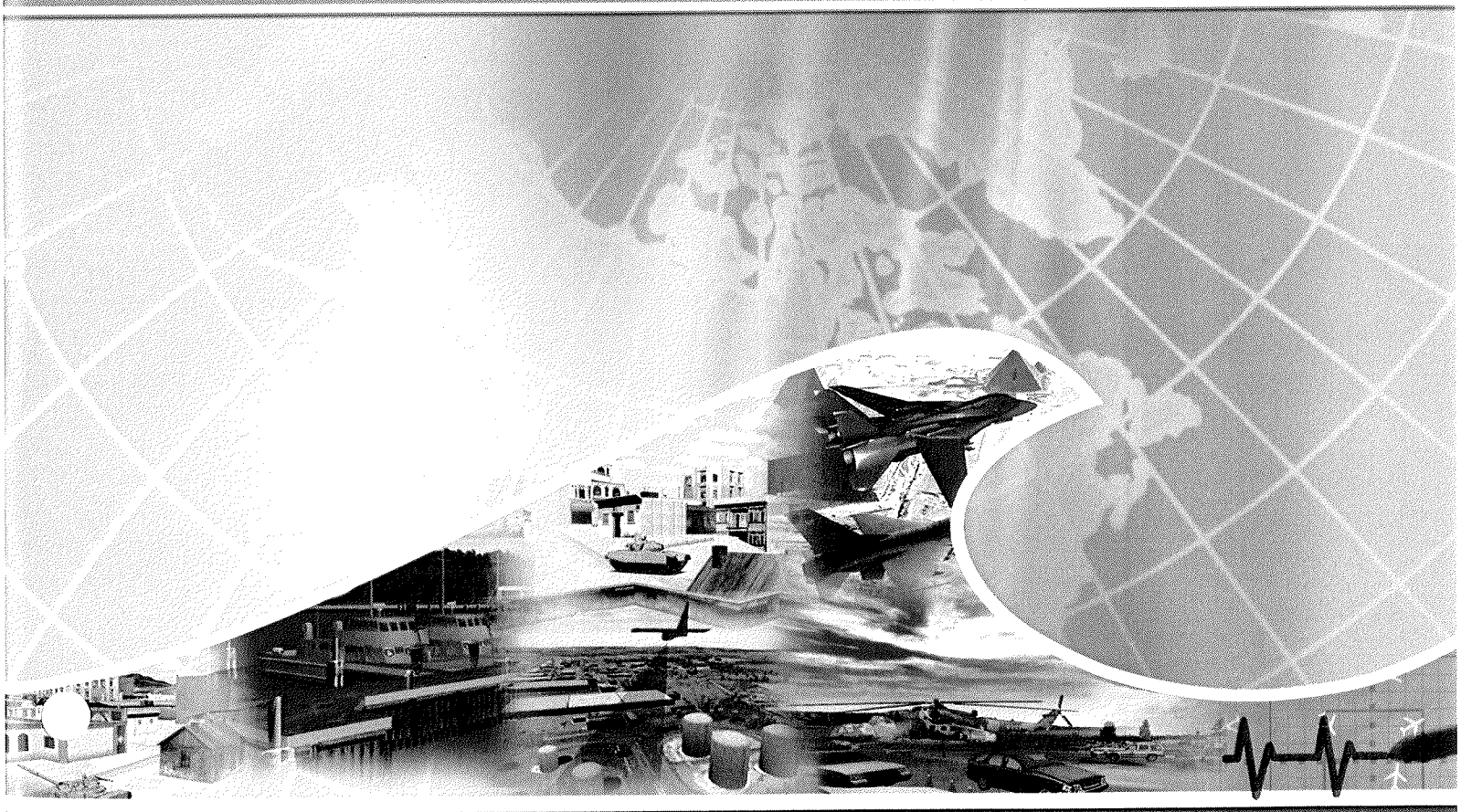


September 15-18, 2008

The Virginia Beach Convention Center
Virginia Beach, Virginia

Paul Fostick - MODSIM World 2008 Program Chair

Mr. Paul Fosdick is currently the Technical Director for Modeling and Simulation for Northrop Grumman Mission Systems in the Hampton Roads area. He has more than 28 years of modeling and simulation experience including providing M&S support to the Joint Warfighting Center and the Emergency Management Training, Analysis, and Simulation Center both in Suffolk, Virginia. These centers are co-located with the Old Dominion University's Virginia Modeling, Analysis and Simulation Center. Mr. Fosdick also is an advisor to the modeling and simulation board for the All Hazards Consortium. Mr. Fosdick is also currently an adjunct professor in Simulation and Gaming for ECPI College in Virginia Beach, Virginia and has over 20 years experience teaching computer science at various universities. Mr. Fosdick received his bachelor of science from Regis University in Denver, Colorado, his master's of science in Computer Information Systems from Southern Illinois University at Edwardsville, and is currently enrolled in the PhD in Modeling and Simulation at Old Dominion University.

MODSIM WORLD is a unique multi-disciplinary International Conference & Exposition for the exchange of modeling & simulation knowledge, research, and technology across industry, government, and academia.

This year, the conference focus is on Decision-Making in Complex Environments. Speakers, educational tracks, presentations, and product demonstrations will center on using modeling and simulation tools and practices in decision-making in today's challenging operating environments. Attendees will learn about new applications and practices and have an opportunity to network with other industry professionals.

table of contents

schedule of events

Monday, September 15

12:00pm - 5:00pm
Exhibit Hall Opens for Set Up

1:00pm - 5:00pm
MODSIM Workshops Only

6:00pm
VIP Reception
Invitation Only
Co-hosted by the MODSIM Executive Committee and The Embassy of Canada; co-sponsored by HREDA

Tuesday, September 16

7:00am - 10:00am
Registration

7:00am - 8:30am
Continental Breakfast
Sponsored by BAH

8:30am - 6:30pm
Exhibit Hall Open

8:30am - 10:00am
Welcome & Plenary

10:00am - 10:30am
Break
Sponsored by EVMS

10:30am - 12:00pm
Session 1 - All Tracks: Speakers, Panel Discussions, Paper Presentations

12:00pm - 1:30 pm
Lunch
Sponsored by Raytheon

1:30pm - 3:00pm
Session 2 - All Tracks: Speakers, Panel Discussions, Paper Presentations

3:00pm - 3:30pm
Break
Sponsored by DeVry University

3:30pm - 5:00pm
Session 3 - All Tracks: Speakers, Panel Discussions, Paper Presentations

5:00pm - 6:30pm
Meet & Greet with hors d'oeuvres & cash bar

Wednesday, September 17

7:00am - 9:00am
Continental Breakfast
Sponsored by SAIC

8:30am - 6:30pm
Exhibit Hall Open

8:30am - 10:00pm
Session 4 - All Tracks: Speakers, Panel Discussions, Paper Presentations

10:00am - 10:30am
Break
Sponsored by the City of Newport News

10:30am - 12:00pm
Session 5 - All Tracks: Speakers, Panel Discussions, Paper Presentations

12:00pm - 1:30pm
Lunch
Sponsored by SAIC

1:30pm - 3:00pm
Session 6 - All Tracks: Speakers, Panel Discussions, Paper Presentations

3:00pm - 3:30pm
Break
Sponsored by the City of Suffolk

3:30pm - 5:00pm
Session 7 - All Tracks: Speakers, Panel Discussions, Paper Presentations

5:00pm - 6:00pm
Pre-banquet reception with cash bar

6:00pm - 8:00pm
Banquet & Awards
Sponsored by the Cities of Chesapeake and Portsmouth

Thursday, September 18

7:00am - 9:00am
Continental Breakfast
Sponsored by the City of Norfolk

8:30am -12:00pm
Exhibit Hall Open

8:30am - 10:00pm
Session 8 - All Tracks: Speakers, Panel Discussions, Paper Presentations

10:00am - 10:30am
Break
Sponsored by the City of Norfolk

10:30am - 12:00pm
Session 9 - All Tracks: Speakers, Panel Discussions, Paper Presentations

12:00pm
Conference Adjourns

12:00pm - 5:00pm
Exhibit Breakdown

Tuesday: 8:45am - 9:00am **Welcoming of the Participants to Virginia and to the Conference**

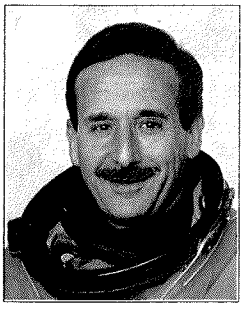
Secretary Patrick Gottschalk, Virginia Secretary of Commerce and Trade

On January 15, 2006, Patrick O. Gottschalk was appointed by Governor Tim Kaine as the Secretary of Commerce and Trade for the Commonwealth of Virginia. The Commerce and Trade Secretariat includes 13 government agencies dealing with such issues as promoting statewide economic growth, community development, attracting and retaining business, promoting the State's tourism, racing and film industries, addressing the need for moderate and low income housing, regulating professions, ensuring safe workplaces, pursuing international markets for Virginia products, developing and conserving energy and mineral resources, administering the State's unemployment compensation program and funding infrastructure projects for localities.

Secretary Gottschalk was formerly a partner in the corporate and international sections of the law firm of Cantor Arkema, P.C. in Richmond, Virginia. His practice focused primarily on corporate law, mergers and acquisitions, international business transactions, financing transactions, and economic development projects. He also served as counsel to the Virginia Economic Developers Association and was an ex officio member of the Board of Directors of VEDA. Secretary Gottschalk also served on the Economic Development Committee of the Virginia Chamber of Commerce. Prior to joining the Kaine Administration, Secretary Gottschalk was very active in the economic development community and participated in several domestic and international trade missions with a variety of former Governors. Secretary Gottschalk has also closed economic development projects throughout the State. Secretary Gottschalk graduated from the University of Virginia School of Law in 1983. While at UVA, he served on the editorial board of The Virginia Journal of International Law. His undergraduate degree, granted in 1975, is from the United States Naval Academy. Upon graduation, he served as a naval officer for five years with assignments aboard the USS Harry E. Yarnell and at the University of Virginia as an NROTC instructor.

Tuesday: 9:00am - 10:00am - Plenary Session Speaker

Charles J. Camarda, Ph.D. - NASA ENGINEERING & SAFETY CENTER, NASA JOHNSON SPACE CENTER - Upon completing his B.S. degree from the Polytechnic Institute of Brooklyn, Camarda began work for NASA's Langley Research Center, Hampton, Virginia, in 1974. He was a research scientist in the Thermal Structures Branch of the Structures and Materials Division and was responsible for demonstrating the feasibility of a heat-pipe-cooled leading edge for Space Shuttle by analysis, laboratory experiments, and aerothermal testing in Langley's 8-foot High Temperature Tunnel. He conducted analytical and experimental research in heat pipes, structural mechanics and dynamics, heat transfer, and numerical optimization for aircraft, spacecraft, and space launch vehicles. While at Langley, Camarda earned his masters' degree from George Washington University in Engineering Science with emphasis on mechanics of composite structures at elevated temperature and his doctorate degree from Virginia Polytechnic Institute and State University with emphasis on the development of advanced modal methods for efficiently predicting transient thermal and structural performance.



In 1989, Camarda was selected to lead the Structures and Materials Technology Maturation Team for the National Aero-Space Plane (NASP) program, which was responsible for maturing materials and structures technologies necessary to enable the development of an air breathing hypersonic vehicle capable of horizontal take-off to orbit. Camarda was selected to head the Thermal Structures Branch (TSB) in 1994 with responsibility for a research engineering staff, two major focused programs (the high-speed research (HSR) and reusable launch vehicle (RLV) programs), and several structural test facilities including the Thermal Structures Laboratory. Some of the primary responsibilities of the TSB are the development of durable, lightweight metallic thermal protection systems (TPS), advanced leading edges for hypersonic vehicles using carbon material and heat pipes, reusable cryogenic tank systems, and graphite-composite primary structure for RLV. Camarda has received over 21 NASA awards for technical innovations and accomplishments. He also received a Research and Development 100 award from Industrial Research Magazine for one of the top 100 technical innovations of 1983 entitled "Heat-Pipe-Cooled Sandwich Panel." He holds 7 patents and one patent pending. Dr. Camarda flew as MS-5 on the Return to Flight mission STS-114 Discovery (July 26-August 9, 2005), and has logged over 333 hours in space. He also served as Director, Engineering, Johnson Space Center. Dr. Camarda is currently assigned to the NASA Engineering and Safety Center (NESC). Through the NESC, Dr. Camarda will use his technical expertise to evaluate problems and supplement safety and engineering activities for Agency programs.

Tuesday: 12:00pm - 1:00pm - Lunch Speaker

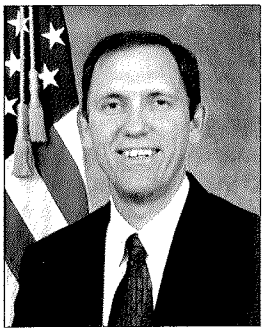
Dr. William F. Dunn, Associate Professor of Medicine, has served on staff at Mayo Clinic Rochester since 1989. An intensivist and pulmonologist, he served as the director (or co-director) of the Mayo Multidisciplinary Critical Care Fellowship for fifteen years, between 1992 and 2006, and has also served as co-director of the Mayo Pulmonary-Critical Care Fellowship. As an active educationalist and Harvard Macy Scholar, he has spearheaded innovation within the Critical Care training environment at Mayo, in a multidisciplinary setting. He has been a recipient of multiple awards for excellence both within and outside Mayo, including Fellowship in the American Colleges of Critical Care Medicine and Chest Physicians, the Mayo Karis Award (clinical excellence), the Mayo Excellence in Teamwork Award, and the Mayo Dept of Medicine Excellence in Innovation Award. Dr. Dunn embraces the concept of simulation as a transformational change in the way many aspects of medical education need to occur in the coming decades, especially given the mandate of both improved medical education and patient safety. He has worked closely with many leaders of the national simulation "movement" and greatly admires the contributions of the pioneers in this field. He has served (since its inception) on the Board of Directors and Editorial Board of the Society for Simulation in Healthcare (http://ssih.org). As a member of the board of this society, he co-chaired the 2005 International Meeting on Medical Simulation. He is current the president of this organization of over 2000 members.

Dr. Dunn has thus led an aggressive charge toward opening the "eyes and minds" of the Critical Care community toward embracing simulation-based education as a standard component of Critical Care training. He embraces the concept of simulation as a transformational change in the way many aspects of medical education need to occur in the coming decades, and is a recognized leader internationally in this realm. He has chaired and participated in multiple patient safety and quality courses and panels, focusing especially in simulation-based applications. These events have occurred within the Society for Technology in Anesthesia (STA), American College of Chest Physicians (ACCP), and the Society of Critical Care Medicine (SCCM), among others. He served as editor on the book "Simulators in Critical Care and Beyond," published by SCCM Press (2004). This work focused on bringing the messages of the non-critical care simulation community into focus for the critical care community, as an outgrowth of an SCCM-sponsored postgraduate course of the same topic. Dr. Dunn has led a multidisciplinary group of Mayo educators (representing the multiple departments and Mayo Clinic School of Medicine) to the establishment of the Mayo Clinic Multidisciplinary Simulation Center, which opened in October 2005 (http://www.mayo.edu/simulationcenter/). This center serves as an international model of experiential education in healthcare, and is utilized by many clinical specialties at Mayo, working collaboratively. Initial utilization of the center both quantitatively and qualitatively has been judged by independent observers as unprecedented for a US academic medical institution. Nationally, his efforts have included Congressional lobbying thru the organization AIMS (Advances In Medical Simulation), leadership through his position within the Executive Committee of the Society for Simulation in Healthcare, and via his editor's position on three academic journals.

Dr. Dunn has always been, and remains, an active clinician. In addition to caring for pulmonary outpatients, 50% of his professional time is spent staffing Critical Care Units, making him among the most active clinical intensivists at Mayo. Former duties have also included staffing the pulmonary function laboratory, being Medical Co-director of the Rochester Methodist Hospital Multidisciplinary Intensive Care Unit, and directing the Mayo Pulmonary Outreach Consultation Program, among others. Pro bono work has included various efforts (medical and humanitarian) in Honduras, El Salvador, Alaska, and Nigeria.

Wednesday: 9:00am - 10:00am - Defense & Homeland Security Track: Session 4 Speaker

Dr. Roger Smith is the Chief Technology Officer and Chief Scientist for Simulation, Training and Instrumentation (STRI).



He is responsible for providing technology strategy and guidance in support of the STRI Program Executive Officer's mission to provide materiel solutions and services in modeling, simulation, training and test/instrumentation to support the Soldier. He is currently focused on: leveraging high performance computers to support interactive simulation, adopting game technologies to serve as effective training systems, using modern IT architectures to improve the efficiency of simulation center operations, adapting web 2.0 collaboration tools for exercise planning and data preparation, and applying simulation tools to medical education.

PEO STRI annually executes programs valued at more than $2 billion with a workforce that includes over 900 military, civilian, government and industry personnel. Acquisition programs cover 463 contracts valued at more than $6.7 billion and support 334,000 training systems at 516 sites worldwide, including 15 countries. In addition, PEO STRI's Foreign Military Sales program supports 52 countries. Dr. Smith began his professional career as an Operations Analyst for the F-16 fighter program in Fort Worth, Texas. He conducted multiple studies on aircraft survivability and vulnerability, chemical weapons effectiveness, air and space defense systems, and national overhead intelligence systems. He was a founding member of a $50 million laboratory designed to conduct system-of-system engineering studies incorporating weapons and C4I systems from all services.

Dr. Smith moved to Northern Virginia to develop and field Army simulations of intelligence systems and supported training in Germany, South Korea, and multiple CONUS locations. He also developed analytical and training simulations for several national

intelligence agencies. Immediately prior to joining PEO STRI, Dr. Smith worked on simulations for testing the Future Combat System, system architecture for OneTESS, and cost estimation tools for the Joint Advanced Distributed Learning CoLab. He has been a very active member of the simulation profession, publishing over 120 technical and management papers, and has served on the faculties of four universities. Dr. Smith holds a B.S. in Applied Mathematics, M.S. in Statistics, Master's in Business Administration, and Ph.D. in Computer Science.

Wednesday: 12:00pm - 1:00pm - Lunch Speaker

Dr. Alexander Kott earned his PhD in 1989 from the University of Pittsburgh, Pennsylvania, where his research focused on applications of artificial intelligence for innovative engineering design. Later he directed R&D organizations at technology companies including Carnegie Group, Honeywell, and BBN. Much of his research focused on automation in command and control, particularly in planning and management of air and ground combat.

Dr. Kott's affiliation with DARPA included serving as the chief architect of DARPA's Joint Forces Air Component Commander (JFACC) program, and recently managing the Advanced ISR Management (AIM) program as well as the Mixed Initiative Control of Automa- teams (MICA) program. He initiated the Real-time Adversarial Intelligence and Decision-making (RAID) program focused on the automation of Red Force predictive analysis. He also manages the DARPA program called Multicell and Dismounted Command and Control (M&D C2). Dr. Kott's research interests include dynamic planning in resource-, time- and space-constrained problems, in dynamically changing, uncertain, and adversarial environments. Such complex, multi-faceted problems require effective integration with scheduling, spatial routing, effects estimation, adversarial intent identification, and negotiation. His past research explored several of these challenges in the context of planning Army and Air Force battles, and in transportation systems. A related area of Dr. Kott's research involved dynamic, unstable, and "pathological" phenomena that can be of critical importance in distributed decision-making systems that consist of human and computer-based decision makers, such as military command and control. His recent work has explored tools and techniques that can model, predict and control the dynamics of a decision-making network. Dr. Kott has published over 50 technical papers and served as the editor of a recently published book on Advanced Technology Concepts in Command and Control. A book focused on Adversarial Reasoning will be published in 2006, and a volume titled Information Warfare and Organizational Performance is to appear in 2007.

Wednesday: 6:30pm - 7:30pm - Banquet Speaker

Admiral Luciano Zappata, Italian Navy, North Atlantic Treaty Organization Deputy Supreme Allied Commander Transformation - Admiral Luciano Zappata was born in Rome in 1947. He joined the Naval Academy in 1966 and on completion was commissioned Ensign in May 1970. During his initial tour of duty he served aboard the Italian Navy submarines Enrico Toti, Morosini and Mocenigo. From 1975 to 1978 he served aboard Destroyer Ardito as Communications Officer and Head of the Operations Department. He took command of Corvette Ape in September 1978. From 1979 to 1985 he served as Staff Officer in charge of the development of the Navy Command, Control and Information Automated System. Selected for promotion to Commander in 1982 he held positions within the Navy General Staff and Commander in Chief Naval Fleet as Chief of the Command and Control Section and subsequently Head of the C3 Office.

During the period 1985 to 1988 Admiral Zappata served first as Executive Officer of Frigate Maestrale and later took command of Frigate Espero, participating in the Persian Gulf Operations to ensure freedom of navigation for merchant vessels operating in the region. From 1987 to 1992 he was assigned to the Italian Naval Staff Weapons Department, where he held several appointments in the Combat Systems Division. From 1992 to 1993 he served as Commanding Officer of Cruiser Vittorio Veneto participating in Operation Restore Hope in Somalia and NATO and Western European Union Operations in Former Yugoslavia as Flagship of the NATO Commander, Standing Naval Force Mediterranean. Promoted to Rear Admiral in December 1996, he held the position of Commander of the Second and Third Naval Divisions during Operation ALLIED FORCE - KOSOVO. Subsequently, he held various positions, including Assistant Head of the Navy Development Department, Chief of Staff of Commander in Chief Naval Fleet and Vice Inspector for Naval Logistic Support.

In January 2005, he was promoted to Vice Admiral and served first as Navy Chief of Staff Advisor and then as Deputy Chief of Staff of the Italian Navy. His most recent tour was Advisor to the Chief of Staff of the Italian Defence. He was promoted to Admiral on 26 June 2007 and assumed the position of Deputy Supreme Allied Commander Transformation on 2 July 2007. Admiral Zappata has been awarded the Knight of Italian Military Order and Officer of the Order for Merit of the Republic of Italy.

Introduction to Simulations, System Dynamics, and Stella: An Earth "Systems" Science Workshop

In this workshop, attendees will be introduced to using simulations and Stella to teach Earth science as a system. Drs. S. Raj Chaudhury (CNU) and Lin H. Chambers (NASA Langley) will demonstrate how to utilize these tools in a classroom, "system dynamics modeling" environment. They will also demonstrate system dynamics as a computer modeling technique that can be used to produce dynamic simulation models for teaching and learning earth science as a system. The basics of a system dynamics software package called Stella will be introduced and modeling exercises that utilize the Stella software will be undertaken in the workshop. No prior modeling experience or use of Stella is necessary, however, participants are required to bring a lap top to the workshop.

Pre-Conference Workshop Leaders:

Dr. Lin H. Chambers
Science Directorate
NASA Langley Research Center

Dr. S. Raj Chaudhury
Department of Physics, Computer Science, and Engineering
Christopher Newport University

Participants are REQUIRED to bring a lap top to the workshop.

Modeling and Simulation - An Introduction for Health and Medical Professionals

Most health and medical professionals are hearing the terms "modeling" and "simulation" (M&S) with greater frequency in their disciplines. In this workshop, Drs. Holly Gaff (VMASC, ODU) and Gianluca DeLeo (VMASC, ODU) will cover the core concepts of M&S using tangible examples from health and medicine. Two major areas addressed will include: (1) simulator and physical simulation, and (2) mathematical modeling and computer simulations. No prior knowledge of M&S is expected. Participants will acquire a basic understanding of M&S in order to truly benefit from the subsequent MODSIM World Conference and appreciate how M&S is transforming healthcare.

Pre-Conference Workshop Leaders:

Holly Gaff, PhD
College of Health Sciences
Virginia Modeling, Analysis & Simulation Center,
Old Dominion University

Gianluca De Leo, PhD, MBA
College of Health Sciences
Virginia Modeling, Analysis & Simulation Center,
Old Dominion University

Introduction to Concept Development and Experimentation: A Recognized Military Method

Concept Development and Experimentation designates a method which allows us to predict, by way of experimentation, whether certain concepts, theoretical constructs, sub-systems or systems are apt to meet the requirements imposed by the transformation process and can be gainfully integrated into an overarching system. Any conference attendee who wants to augment their skill set with techniques found to be of value in getting new capability quickly into the hands of war fighter. Attendees will learn terminology, fundamentals of operational concept development, fundamentals of operational experimentation, the application of these techniques to strategic, operational and tactical challenges. The instructors for this workshop are experienced practitioners from Allied Command Transformation (NATO) and Experienced practitioners from U.S. Joint Forces Command.

Introduction to Certified Modeling and Simulation Professionals

"Introduction to Certified Modeling & Simulation Professionals" (CMSP) will be held on Monday, September, 15, 2008, from 1:00 - 3:00 PM as a MODSIM World 2008 pre-conference workshop. The workshop will present the current examination process and the expected revisions to the process, as well as an overview of the content currently employed CMSP Exam. Anyone interested in knowing more about the current (and proposed revisions to) Certified Modeling & Simulation Professionals (CMSP) process and examination should attend to learn the processes to certify and re-certify, the fundamental topics that are covered by the exam, as well as insights on how to best prepare for the certification exam.

Pre-Conference Workshop Leader:

Dr. Amy E. Henninger
Institute for Defense Analysis (IDA)

Dr. Edward J. Degnan
Division Chief, M&S Foundations Division

Jeffrey W. Wallace
CTO, Carpe Occasio
Technology Systems

Business Development in the Modeling and Simulation Arena

This tutorial is focused on the Canadian Trade Mission, and as such, will specifically address regulations regarding trade Canadian / US. However, the general aspects of the tutorial such as business development in Virginia and Hampton Roads as well as information on University research programs are applicable to all conference attendees. This MODSIM World 2008 pre-conference workshop will be held on Monday, September, 15, 2008, from 2:00 - 5:30 PM. All Canadian Trade Mission members and any conference participants interested in learning about strengths, weaknesses, opportunities and threats to conducting M&S business in Hampton Roads should attend.

Tutorial Outline:

- Canadian Embassy welcome and introduction to the tutorial
- Canadian Honorary Counsel in Virginia - (invited)
- Virginia Economic Development Partnership
- The Prime/Sub relationship
- SAIC
- Mymic, LLC
- Doing Business with Universities
- Old Dominion University "International Business Visitors' Center"
- Canadian Trade Commissioner Wrap Up
- Canadian Only Session

The Instructors - Experienced trade and business development experts.

CLOSED SESSION

Track Co-Chairs: Michele Darby, Juergen A. Klenk, and Bruce Milligan

Natural and man-made biological threats, public health emergencies, and uncontrollable costs threaten to overwhelm today's educational and healthcare delivery systems, and society. In response to these challenges, subject matter experts, administrators, and simulation developers must collaborate to develop cost-effective, serious games and simulations allowing for better analysis of complex systems for improved incident action plans, decision making, and training. The Health and Medicine Track provides a forum for experts and stakeholders from a variety of disciplines to share advances, identify and solve problems, and foster future research opportunities that expand the role of modeling and simulation to dramatically improve patient outcomes and overall disaster response.

Tuesday
Plenary Session: 8:30-10:00

Session 1: 10:30-12:00
Plenary Session - Disaster Preparedness and Public Health

Nathaniel Hupert, Cornell University

Chair - Juergen Klenk
Co-Chair - Michele Darby
Moderator - Juergen Klenk

Session 2: 1:30-3:00
Panel – Bridge between Emergency Care and Emergency Preparedness

Kaleen Lawsure and Whitney Sokolowski, Virginia Modeling, Analysis & Simulation Center, Old Dominion University, Regional Tertiary Care Center Disaster Response Model; Dr. Peter Highnam, HHS BARDA; Lee Cox MSN, RN (speaker); David Walton BS, Clinical Simulation Centers, Radford University School of Nursing Simulation enhanced emergency preparedness training; Michael T. Handrigan, MD, FACEP, Senior Medical Officer, Emergency Care Coordination Center, HHS

Chair - Juergen Klenk
Co-Chair - Michele Darby
Moderator - Dr. David Marcozzi, Director, Medical Preparedness Policy, White House Homeland Security Council

Session 3: 3:30-5:00
Paper presentations: Cost-effective approaches to simulation in healthcare

James Ritchie, CDR, Navy Emergency Physician, Naval Medical Center, Portsmouth, VA:
The Contraption: A Low-Cost Participatory Hemodynamic Simulator

Mary Ann Notarianni, Associate Professor, School of Nursing, Old Dominion University:
Low Tech Simulations to Teach Nursing Students Educational Strategies for low health literacy aggregates

Stacie Ringleb PhD, Old Dominion University, Department of Mechanical Engineering: Medical Modeling and Simulation without Computers: Use of Cadavers to Simulate Injuries, Pathologies and Treatment

Dr. Azhar Rafiq, VCU-NASA: Effectiveness of real time feedback on training surgical skills using simulated tissue interface

Chair - Juergen Klenk
Co-Chair - Michele Darby
Moderator - Leonard Sledge, Development Officer, College of William & Mary

Wednesday
Session 4: 8:30-10:00
Welcome & Plenary Session - Current state and future of Serious Games and Learning in Healthcare

Ben Sawyer, Founder, Serious Games Movement:
Games for Health

Michelle Roper, FAS Learning Technologies Program Director:
Learning & Technology

Chair - Bruce Milligan
Co-Chair - Michele Darby
Moderator - Bruce Milligan

Session 5: 10:30-12:00
Panel - State-of-the-art serious games in health demo session

Douglas Whatley, BreakAway, Ltd Pulse; Christine Shamloo, Washington Hospital Center; Alex Cohen, Federation of American Scientists, Immune Attack Code Orange

Chair - Bruce Milligan
Co-Chair - Michele Darby
Moderator - Bruce Milligan

Session 6: 1:30-3:00
Plenary Talk - Preventing Medical Errors Using Simulations

Dr. Jana Berryman, Work, Education and Lifelong Learning Simulation (WELLS) Center, Colorado Center for Nursing Excellence:
Preventing medical errors with utilization of high fidelity simulation and VH Dissector training with a collaborative model

Gerry Higgins, Washington Hospital:
Center Simulation and Training Environment Lab

Nikos Chrisochoides, Center for Real-Time Computing and Computer Science Department, College of William and Mary:
Near real-time non-rigid registration for image guided neurosurgery

Chair - Bruce Milligan
Co-Chair - Michele Darby
Moderator - Dr. Azhar Rafiq

Session 7: 3:30-5:00
Paper Presentations - Serious Games and Simulations - Training Health Professionals

Karen Kott, Associate Professor, School of Physical Therapy, Old Dominion University:
Virtual Reality Gaming for Treadmill Training: Improving Functional Ambulation in Children with Cerebral Palsy

Jacqueline Fried, Director, Division of Dental Hygiene, School of Dentistry, University of Maryland:
Simulation: A pathway to excellence in dental hygiene education

Howard Mall, ECS, Inc.: Tactical combat casualty care simulation

Kay Palmer, Associate Professor, School of Nursing, Old Dominion University:
Combining simulation venues for clinical practice teaching

Chair - Bruce Milligan
Co-Chair - Michele Darby
Moderator - Stacie Ringleb PhD - Department of Mechanical Engineering, Old Dominion University

Thursday
Session 8: 8:30-10:00
Panel - Preparedness/Surveillance

Natalia Machuca, M.S. - Infectious Disease Program Manager, Association of Public Health Laboratories:
The public health environment and the pandemic problem

Dr. Juergen Klenk, Booz Allen Hamilton:
Flu Lab Capacity Modeling

Dr. Joseph Miller, Influenza Division, Centers for Disease Control and Prevention:
Results and insights gained from Flu Lab Capacity Modeling

Dr. Yuri Millo, Director, Washington Hospital:
Center Simulation and Training Environment Lab

Chair - Bruce Milligan
Co-Chair - Juergen Klenk
Moderator - KC Decker

Session 9: 10:30-12:00
Panel - Health Training with new technologies - What works and what doesn't

C. Donald Combs PhD, Professor of Health Profession, Associate Dean for Planning and Health Profession, and Robert J. Alpino, Senior Staff Member, Office of the Associate Dean for Planning and Health Profession, Eastern Virginia Medical School: The Evolution of Medical Modeling and Simulation

Paul Marshall, Naval Medical Center, Portsmouth:
Naval Training at the SimCenter

Mark Scerbo, Professor, Department of Psychology, Old Dominion University:
Fidelity Issues in VR Displays

Gayle Gliva-McConvey, Director, The Teresa A. Thomas Professional Skills Teaching and Assessment Center, Eastern Virginia Medical School:
Standardized Patients

Chair - Bruce Milligan
Co-Chair - Juergen Klenk
Moderator - Mark Scerbo, ODU

Track Chair: John Garcia

In today's rapidly changing business environment, an advanced decision support system offers decision-makers flexibility for problem solving and credibility in resulting solutions. Modeling and simulation (M&S) tools and visualization technologies enable improved designs and operations for land, air and sea transportation systems. Analytical tools support predictions of complex transportation system performance. When combined with advanced information displays, and decision support tools, these M&S technologies can be used to test and improve the safety of transportation and logistics systems operations and provide aid to decision makers in business development, local and state planning activities, and emergency management and homeland defense. For example, traffic congestion is one of the worst problems in many countries. Traffic congestion wastes a huge portion of the national income for fuel and traffic-related environmental and socioeconomic problems. Computer simulation is a powerful tool for analyzing complex and dynamic scenarios. It provides an appealing approach to analyze repetitive processes. Simulation helps decision makers identify different possible options by analyzing enormous amounts of data. Hence, computer simulation can be used effectively to analyze traffic flow patterns, evacuation routes etc. These simulations greatly reduce the cost and risk of testing and, because they enable a large number of scenarios to be evaluated, increase the reliability and safety of the final system design. Transportation and logistics systems models may also be coupled to enable the security and cost of multimodal transportation operations to be assessed. In addition, derivative simulations may be used for other applications including training and decision support for business development, local and state planning for ports, roads, and airports, and emergency response.

Tuesday
Plenary Session: 8:30-10:00

Session 1: 10:30-12:00
Speakers

Rob Lisle NG SY; Peter Lattimore; VDOT

Chair - John Garcia

Session 2: 1:30-3:00
Papers - Commercial Transportation and Logistics

Tapestry Solutions; Rejo Mathew; Ford Cook

Chair - John Garcia

Session 3: 3:30-5:00
Cross-track Panel - Disaster preparedness and response planning

Dr. Yuri Millo - Director Washington Hospital Center Training Lab; William Thompson, Influenza Division, CDC; Camelia Ravanbakht, Ph.D., Principal Transportation Engineer, Hampton Roads Planning District Commission; NN (State or Local Government); Dr. Mike Pack

Chair - Michele Darby
Co-Chair - John Garcia

Wednesday
Session 4: 8:30-10:00
Panel - Defense Related Issues

CDR Bill Parrish; Col Lamp - JFCOM J8; Ford Cook; Dr. Jim Lethrum

Chair - John Garcia

Session 5: 10:30-12:00
Cross-track Panel - Transportation and Logistics and Gaming

MGD Game, Army War College; DMCTI from RDECOM; Dr. Mike Pack

Chair - John Garcia
Co-Chair - Alicia Sanchez

Session 6: 1:30-3:00
Papers - Transportation and Logistics Research

Syed Rizvi; Srinivas Karthik; Hector H. Guerrero, PhD

Chair - John Garcia

Session 7: 3:30-5:00
Demonstrations - Transportation and Logistics Demonstrations

ODU/PORTSIM; CATT Lab – UMD; Peter Lattimore Rhino Corps

Chair - John Garcia
Co-Chair - William & Mary

Track Co-Chairs: James G. Batterson and Rasha Morsi

The Engineering and Technology Track is new to the MODSIM World Conference this year. Because the wider use of modeling and simulation in industry and national labs has developed recently and independent from the formal P-16 education system, the objectives of engineering track this first year are two-fold:

1. To provide a broad general audience with concrete examples of how modeling and simulation is currently being used in diverse areas in the research, technology, development, and operational communities, and
2. To provide an alignment "handshake" between the formal education community and professional engineering user community.

The presentations in the Engineering and Technology Track are geared for a general audience from diverse backgrounds and are meant to showcase some of the very broad set of applications that modeling and simulation currently supports even as this number continues to grow every day. There will be nine sessions. Four sessions will focus on actual applications to engineering areas such as aerospace, earth and planetary science, civil, mechanical, and marine engineering, and engineering project management. A session will be devoted to a panel discussion of modeling and simulation in K-16 formal education and its alignment with some workplace needs. One session will provide an in-depth look at modeling and simulation as it is being applied to engineering education in a multi-player game environment at the university level. A session will look at emerging modeling and simulation capabilities as seen from the viewpoint of a major software developer. Two sessions have been set aside for the purpose of visiting the vendors. Vendors will expect and provide appropriate staff for visits from the engineering track participants during these specific times.

Tuesday
Plenary Session: 8:30-10:00

Session 1: 10:30-12:00
Presentations - M&S in Engineering & Technology 1: Aerospace

The three presentations in this session focus on aerospace engineering. Steve Alter of NASA Langley Research Center will discuss how both experimental modeling and simulation (hypersonic wind tunnel) and computer simulations (computational fluid dynamics) are combined during space shuttle flights to make recommendations on whether to repair thermal tile damage that may have occurred during ascent to orbit before the vehicle can safely return to Earth. Actual pictures and data will be provided. Alex Kokolios of the Patuxent River Naval Air Station will discuss how simulation is used by the Navy in its fighter procurement process. The third presentation addresses an issue that should be a great interest to anyone who has traveled by air recently! Mark Ballin of NASA Langley Research Center will talk about the networking of several special facilities to provide a comprehensive simulation environment to examine current and next-generation air traffic management options.

Space Shuttle Tile Damage Assessment for Earth's Atmosphere Re-entry Decision-making:
Steve Alter, NASA LaRC;

A Multi-Facility Simulation Network for Air Traffic Management Research:
Mark Ballin, NASA LaRC

Aircraft Simulation in the Naval Aviation Acquisition Process:
Alex Kokolios, Patuxent River NAS

Chair - James Batterson

Session 2: 1:30-3:00
Presentations - M&S in Engineering & Technology 2: Science

These three presentations focus on planetary and atmospheric science applications. Jill Prince and Eric Queen of NASA Langley Research Center will discuss the applications of modeling and simulation that were employed to assure the recent successful Phoenix spacecraft soft-landing on Mars. This is the spacecraft that is currently examining the planet's surface for clues of water and other indicators of a potential life-supporting environment. Jie Wang of Old Dominion University will present a simulation analysis of planetary cratering and Dave McDonnell of NASA Langley Research Center will discuss employing simulations for the development of the CALYPSO spacecraft instrumentation for on-orbit atmospheric data sampling.

Phoenix Spacecraft Entry, Descent, and Landing on Mars: Eric Queen, NASA LaRC; Jill Prince, NASA LaRC

Crater Modeling on Synthesized Terrain: Jie Wang, Old Dominion University; Yushong Shen, Old Dominion University

On-orbit Simulation for the CALYPSO Spacecraft: Dave McDonnell, NASA LaRC

Chair - Rasha Morsi

Session 3: 3:30-5:00
Presentation - Emerging Modeling and Simulation Capabilities

This entire session will showcase Tom Lee from Maplesoft Corporation headquartered in Waterloo Canada, who will provide a fascinating look into emerging challenges and trends in modeling and simulation from the software makers point of view. He will also discuss the state-of-the-art capabilities and some thinking about meeting emerging needs in the next decade or more.

From Space Robots to Next Generation Automobiles: Emerging Challenges and Trends in Engineering Modeling and Simulation: Tom Lee, Maplesoft Corp, Waterloo, CN

Chair - James Batterson

Wednesday
Session 4: 8:30-10:00
Panel - Vertical Panel on M&S in Engineering & Technology: K-12, CC, University, Industry

Industry and research laboratories have used modeling and simulation to some extent for years. Engineers, scientists, and technicians have learned their modeling and simulation skills through on-the-job training. Only recently has the formal education structure begun to embrace these skills in the formal curriculum. Modeling and simulation can be taught in either or both computer-aided design of new systems and/or the modeling and analysis of extant dynamical systems. Representatives from the K-12 world, community college, and 4-year university will talk about their offerings while Bruce Jackson will talk about how he and his organizations at Patuxent River NAS and NASA have used modeling and simulation in development of a wide range of manned and unmanned flight vehicles.

Mark Clemente, Virginia Beach Public Schools; Bill Jackson, Virginia Beach Public Schools; Jody Strasser, Tidewater Community College; Roland Mielke, Old Dominion University; Bruce Jackson, NASA LaRC

Chair - James Batterson

Session 5: 10:30-12:00
Presentations - M&S in Engineering & Technology 3: Civil, Mechanical, and Marine Design

Two presentations will look at some "down-to-Earth" applications. Harry Wang of the Virginia Institute of Marine Science will discuss mathematical models that are used to simulate tidal level change in the Hampton roads and Chesapeake Bay region. This is a very timely presentation of the nuts and bolts behind some of the data that are currently informing development of

public policy. The ability to computationally model and simulate air flow in unique geometries allowed the design architects to achieve sufficient heating and cooling in the uniquely shaped Marine Corps Museum atrium. This innovative use of computational fluid dynamics (CFD) has been made possible by the incredible new speed and memory capacities of computers. Kerry Spinks of Hankins and Anderson in Richmond, VA will provide the details on the design and analysis project and successful results.

Chair - Rasha Morsi

Session 6: 1:30-3:00
Presentation - Game-Based Learning

Each track in MODSIM World 2008 has a session devoted to game-based learning. This entire session is devoted to Masa Okutsu of Purdue University who will discuss work that he and his colleagues in the college of engineering are completing in the development of a multi-player on-line game to support the teaching of engineering design at the university level.

Teaching an Engineering Design Course via Multi-Player Online Serious Game: M. Okutsu, D. DeLaurentis, S. Brophy, Purdue University

Chair - Rasha Morsi

Session 7: 3:30-5:00
Visit The Vendors

After MODSIM World 2007, several vendors suggested that they could better accommodate and serve their visitors if they knew what skills they were to expect visit at various times. This is one of two time slots that the engineering and technology track has reserved for visiting the vendors. The booths should be staffed during these times (Session 7 and Session 9) specifically for visitors from the engineering track.

Thursday
Session 8: 8:30-10:00
Presentations - M&S in Program & Project Design & Management

Modeling and simulation has value in all areas of systems. This session is devoted to project and organizational management examples. Vince Bilardi of NASA Glenn Research Center will discuss management of the Ares I-X rocket upper stage development, a key component of the nation's strategy to replace the aging Space Shuttle fleet. Jason Derleth of NASA HQ will discuss the large NASA project, Constellation, that develops a system of boosters and spacecraft that will enable the nation to return to the moon and go beyond to Mars.

Ares I-X Upper Stage Simulator Manager, Vince Bilardo, NASA Glenn Research Center

Constellation System Dynamics Simulation Model, Jason Derleth, NASA HQ

Chair - James Batterson

Session 9: 10:30-12:00
Visit The Vendors

Medical Modeling and Simulation Database

AMERICAN COLLEGE OF SURGEONS

EVMS
Eastern Virginia Medical School

Welcome to the Medical Modeling and Simulation Database (MMSD) of Eastern Virginia Medical School and the American College of Surgeons

We hope that the Medical Modeling Simulation Database will encourage continued research and collaboration within the simulation community. The MMSD will be updated quarterly to provide the most current research articles and publications available. Last updated: September, 2008.

The MMSD currently contains over 200,000 selected articles. The Research Articles database is a focused database that primarily contains downloaded bibliographic citation data from MEDLINE® in its database. The Companies and Products database contains information on the companies that produce commercially available medical modeling and simulation products. The Simulation Centers and Simulation Sites of Interest database contains information on primarily academic-based research centers conducting work on medical modeling and simulation along with information on their respective research projects. Finally, the Meetings and Conferences database contains information on upcoming medical modeling and simulation meetings and conferences throughout the world. It is our intention to mirror the growth of the simulation community and facilitate collaborative research. If you have any ideas to improve the site, please let me know at mmsd@evms.edu. Thanks!

C. Donald Combs, PhD.
Vice-Provost for Planning
and Health Professions
Eastern Virginia Medical School

NEWS FROM THE COLLEGE

Medical Simulation Web Site Launched

Eastern Virginia Medical School (EVMS), in conjunction with the ACS, has developed a comprehensive database aimed at increasing collaboration among product developers, medical professionals, and researchers in the emerging field of medical modeling and simulation (MMS). The database, publicly available at www.medicalmodsim.com, includes more than 200,000 resources covering all aspects of MMS that previously existed only in a diffuse network of information sources. The database is also aimed at raising general awareness of the field.

"The goal is to increase the use and quality of medical modeling and simulation," said C. Donald Combs, Ph.D., associate dean for planning and health professions at EVMS.

MMS encompasses three main elements: the creation of models that mirror reality with reasonable accuracy, the analysis of such models, and the creation of simulators based on those models. MMS brings virtual reality from the realm of science fiction to the medical classroom and the operating room, and as the field has gained attention, the volume of research and development activity has gone up exponentially.

L.D. Britt, M.D., FACS, chair of the EVMS Department of Surgery and vice-chair of the ACS Board of Regents, helped facilitate the partnership. The move to a partnership fits with the College's national leadership in promoting the use of MMS as a training tool to improve surgical practice. The driving principle behind the database's development is to provide a central jumping-off point for new partnerships in MMS.

The database can be searched using any of nine browse folders, including two that list articles preselected by health care profession or surgical specialty. More browse folders will be added as new areas and demand are identified. For additional details on the medical simulation database, visit www.medicalmodsim.com. ■

Joint Symposium to Focus on Neurotrauma/Critical Care

Members of the ACS are invited to attend the first joint symposium of the National Neurotrauma Society and the American Association of Neurological Surgeons/Congress of Neurological Surgeons Section on Neurotrauma and Critical Care. The meeting, which will take place July 27-30 at the Hilton Walt Disney World in Orlando, Fla, provides an opportunity to learn about the most up-to-date clinical and basic science in neurotrauma and critical care in a collaborative environment.

Through this joint effort, specific clinical sessions have been created for practicing physicians, neurotrauma nurses, and basic scientists. These sessions will help attendees better understand the state-of-the-art management of neurotrauma and critical care through didactic sessions (such as management of traumatic brain injury, spinal cord injury, and intensive care) and hands-on sessions (such as spinal column trauma reconstruction, multimodality monitoring, and surgical management of brain trauma).

The goal of this joint symposium is to create better dialogue and collaboration among clinicians and scientists that might translate into improved patient care in the future.

Attendees will learn what can easily be incorporated into clinical practice and what is on the horizon in neurotrauma and critical care. They can also earn up to 25 hours of AMA PRA Category 1 CME Credits.

For program information and to register, visit www.neurotrauma.org/2008/index.htm#. You may also contact David Adelson, M.D., FACS, FAAP, chair, AANS/CNS Section on Neurotrauma and Critical Care, and chair, Neurosurgery Subspecialty Group, ACS COT, via karen@tlceventsgroup.com. ■

Georgia Redefines General Surgery

After years of grassroots advocacy on the legislative, regulatory, and judicial fronts, Georgia surgeons who fought to have general surgery defined as a single specialty finally achieved victory in the General Assembly. S.B. 433, a certificate-of-need (CON) reform bill, contains language that recognizes general surgery as a single specialty eligible for the exemption from the CON process for ambulatory surgery centers.

The Georgia House passed the bill 138-17, and the Senate quickly followed suit with a 44-7 vote on April 5, the last day of the state's 2008 legislative session. Gov. Sonny Perdue (R) signed the bill into law on April 9.

The ACS undertook major efforts to support the general surgery community in Georgia during this long-term battle. For more information, visit www.legis.ga.gov/legis/2007_08/sum/sb433.htm. ■

Don a Helmet Before You Put the Pedal to the Metal

BY RICHARD J. FANTUS, M.D., FACS

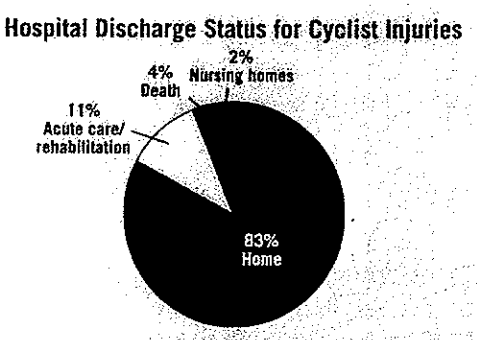
Now that spring is in full swing and the dreary winter weather is merely a bad memory, throngs of bicyclists take to the trails, sidewalks, and, unfortunately, the streets, resulting in the frequent occurrence of a bicyclist being injured by a motor vehicle.

Despite advances in design, head injuries have dated back to the early days of cycling. These injuries likely increased as more and more roads were paved. Fortunately, bicycle clubs recognized this trend, and helmets were first used as far back as 1880. Over the years, the helmet was refined, and national standards were put into place in 1984.

Unfortunately, current helmet use ranges from one extreme to the other, depending on the geographic area and population demographic, with overall use close to 25%.

In order to examine the occurrence of bicyclists injured by motor vehicles in the National Trauma Data Bank Dataset 7.0, we used the International Classification of Diseases, Ninth Revision, Clinical Modification cause of injury code E813.6, Motor vehicle traffic accident involving collision with other vehicle injuring pedal cyclist. In the dataset with this E code, there were 10,680 records with discharge status included.

Of the victims in these records, 8,867 were discharged to home, 1,158 to acute care/rehabilitation, and 221 to nursing homes; 434 died. (See figure and corresponding percentages.) Among victims, 84.5% were male and on average 28.2 years of age; they had an average length of hospital stay of 5.1 days and an average injury severity score of 11.0. Of those bicycle riders tested for alcohol, one-fourth tested positive, whereas one-half of those screened for drugs tested positive.



Note: Based on data for 10,680 records of cyclists injured by motor vehicles.
Source: Dr. Fantus

Information on helmet use was available in 4,129 of the cases, and approximately one-third (1,381) of the injured riders were wearing a protective helmet.

No one can argue the fact that helmets are protective devices and save lives. Otherwise, why would football players, hockey players, and baseball players wear them? When getting ready to mount your metallic steed, do not drink, do not take drugs, and do wear reflective clothing and reflectors after dark. And wear a bicycle helmet—especially if you are heading to the streets—so you will be protected in case you put your pedal to the metal of a motor vehicle.

The full NTDB Annual Report Version 7.0 is available on the ACS Web site as a PDF, and at www.ntdb.org as a PowerPoint presentation.

If you are interested in submitting your trauma center's data, contact Melanie L. Neal, Manager, NTDB, at mneal@facs.org. ■

Acknowledgment

Statistical support for this article has been provided by Sandra M. Goble, M.S.

DR. FANTUS *is director, trauma services, and chief, section of surgical critical care, Advocate Illinois Masonic Medical Center, and clinical professor of surgery, University of Illinois College of Medicine, Chicago, Ill. He is chair of the ad hoc Trauma Registry Advisory Committee of the Committee on Trauma.*

mechanical engineering

FEATURES | DEPARTMENTS | MARKETPLACE | NEWS UPDATE

FEATURE ARTICLE

virtual OR

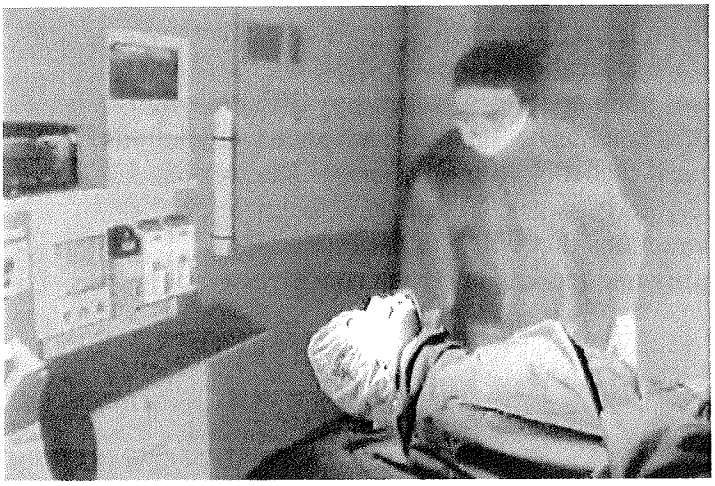
Engineers are developing systems that enable future healers to practice surgery and other skills on model patients in simulated spaces.

by Alan S. Brown, Associate Editor

Cool heads prevail in emergencies, and the coolest heads rest on experienced shoulders. It's the "been there, done that" attitude that comes from time, trial, and error.

But when the stakes are life and death, as they often are in operating and emergency rooms, no one is going to let medical students or residents learn from their mistakes. That's why the medical profession is turning to engineers to develop tools that give doctors crash courses in facing life and death decisions as part of an operating team.

"There's a coordinated sequence of events that has to take place in an operating room," said Leonard Weireter Jr., a surgeon at Eastern Virginia Medical School who also heads Sentara Norfolk General Hospital's Shock Trauma Center. "If the anesthesiologist, surgeon, and circulating nurse know how to communicate with one another, a lot can get done." If not, the ballet devolves into something more like a mosh pit. It can happen quickly in an emergency, such as cardiac arrest or allergic reaction. It may also occur if a member of the operating team misreads an instrument or misunderstands a command.



The virtual operating room allows real surgical students to

interact with virtual instruments, and work with virtual surgeons, nurses, and anesthesiologists.

Today, medical students and residents learn to cope with life-threatening emergencies by living through them. They stand beside skilled practitioners, the same way apprentices learned from their masters for hundreds of years. They watch, assist, and ultimately take the scalpel into their own hands under the watchful eye of an experienced surgeon.

Yet even the busiest hospital presents only a limited range of experiences for any given type of operation. While human beings vary widely, most operations follow a routine set of procedures. Doctors may go through years of medical school and residency, and never encounter more than a handful of true emergencies. They may never confront a life-and-death decision until they are out on their own.

That may be about to change.

Taking a lesson from other professionals who must sometimes face critical decisions—pilots, chemical and nuclear power plant operators, or military officers—the medical profession has begun to use advanced simulations and mechanical feedback to train doctors. The work is still in its very early stages. Yet the new technologies promise interactions that will blur the distinctions between reality and models in virtual space.

Imitation of Life

The concept is simple. Doctors, nurses, and paramedics learn and practice procedures on simulators until they

become proficient. The simulators then vary symptoms to depict medical emergencies that most medical personnel rarely encounter. Future doctors, for example, can rehearse emergency procedures the same way pilots use simulators to learn how to pull out of a spin or fly with a damaged engine.

Over the past decade, several companies have introduced simulators. Most consist of a plastic and rubber mannequin, a haptic feedback system that simulates the resistance of medical instruments moving through the body, and imaging systems that show the locations of the instruments.

Today's medical simulators have limitations, but they are moving rapidly into the medical mainstream. Two years ago, for example, the Food and Drug Administration approved a carotid stent, developed by Guidant Corp. of Indianapolis, that expands blocked arteries in the neck. Before doctors could perform the risky procedure implant, the FDA required doctors to undergo four hours of simulator training.

"This is the first time that FDA required simulator training," said Mark Scerbo, a professor of psychology at Old Dominion University in Norfolk, Va., and co-director of the National Center for Collaboration in Medical Modeling and Simulation. "This may be the start of a new model for training doctors. Simulations can also let us test new devices and procedures without putting patients at risk."

Scerbo is at the forefront of those changes. As a human factors psychologist, he has studied how doctors learn their craft. He is quick to point out the flaws in existing simulators. Each system covers only one specific type of procedure, such as gall bladder removal or ectopic pregnancy (where a fetus grows outside the uterus). While some simulations are realistic, others are not. All are expensive and usually carry six-figure price tags.

More significantly, today's simulators reproduce only a handful of emergency conditions. None teaches the critical thinking and teamwork skills needed inside an operating room.

Scerbo's National Center for Collaboration in Medical Modeling and Simulation wants to change that. It was formed four years ago when Old Dominion's Virginia Modeling and Simulation Center, which has close ties

with the military, teamed with neighboring Eastern Virginia Medical School.

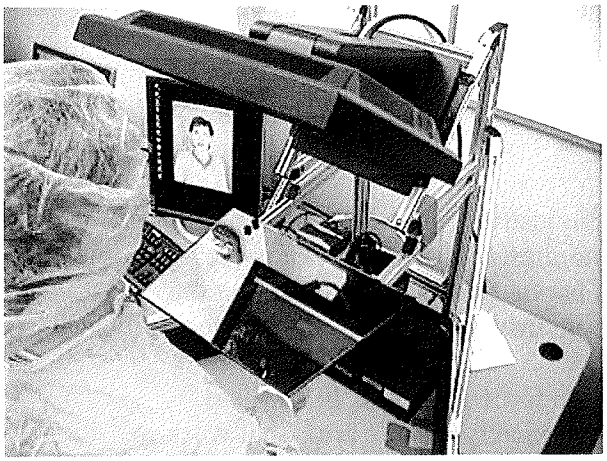
On one hand, the center evaluates existing simulations. "The biggest question medical schools have before they invest a few hundred thousand dollars in a simulator is, ÔDoes it work?' There's no empirical evidence that one is better than another or whether any of them are effective," Scerbo explained. His goal is to quantify their efficacy.

The center also hopes to commercialize new technologies. Its debridement system, for example, uses virtual reality to walk students through cleansing large surface wounds. "A person can come in, practice a skill on a simulated limb, and receive feedback from the system," Scerbo said. "The first time that person sees a patient, he or she can perform the procedure."

Finally, the center is building a comprehensive operating room simulator. The researchers have built a complete operating room around two existing procedures, gall bladder removal and an ectopic pregnancy. Inside that virtual environment, medical students can interact with simulated doctors and nurses while they operate on a mannequin. The unit is intended to train doctors in both critical thinking and teamwork.

The modeling environments and haptic feedback devices now being adapted for surgical training have existed for decades. Why are physicians only just beginning to tap their power? The answer, Scerbo said, involves litigation and changes in operating room practice.

"Medicine is a lightning rod for litigation, and anesthesiology is one of its riskiest specialties," he said. Starting in the late 1980s, anesthesiologists teamed with engineers to reduce operating room errors. They developed training mannequins that simulated such physiological responses as high blood pressure and choking.



A debridement center uses haptic feedback to provide medics with a realistic experience as they remove debris and cleanse a virtual wound.

"One of the most serious issues in the field is intubation, getting a tube down the throat without choking the patient," Scerbo said. "The more you do it, the better you learn. Doctors joke that the reason they call it a practice is because they practice on you and me. With mannequins, they're learning on a device and not on a patient."

The use of mannequin simulators coincided with the advent of minimally invasive, or laparoscopic, surgery. Instead of slicing open a body, surgeons inserted cameras and surgical instruments attached to long rods through small incisions. They then performed the procedure guided by camera displays of the organs.

Minimally invasive surgery reduced recovery times dramatically, but proved difficult to learn. "It's like doing

very sophisticated surgery with chopsticks in your hands," Scerbo said. "It takes a lot of training to look at a two-dimensional display and understand what your instruments are doing. There's a real need to train doctors, and not on patients."

Working laparoscopic instruments takes more than looking at a video monitor. It also requires a sense of touch. Off-the-shelf haptic feedback devices reproduce the forces laparoscopic instruments encounter in the body.

Haptic devices provide force feedback. In surgical simulations, they are typically robotic arms that work in reverse: Instead of applying force to an object, they provide force feedback when someone moves an object. When a student moves a clamp at the end of a robotic arm, the haptic system calculates the amount of force to apply against that motion by gauging how the scalpel interacts with a computer-generated model of tissue in which it moves.

"It's very difficult for a haptic device to replicate what the skin senses, such as the sensation of picking up a tennis ball in your hands," Scerbo said. "It's much easier to replicate the resistance of a rod moving through a body."

Faithful Enough

"For years, we thought medical simulator haptics had to be incredibly precise," Weireter said. "We talked to the Air Force about their high-fidelity models of airflow over an F-16, but the shape of a liver is far more complex than a wing. But we found we didn't need to spend a billion dollars to create high-fidelity haptics."

In fact, students typically learn laparoscopic surgery using low-tech devices. They simply poke their camera and instruments through holes in a black box and practice hand-eye coordination skills, such as transferring objects from one hand to another and tying knots while watching a video display. Simulators eventually add haptic feedback. "It turns out you don't need the high-fidelity haptics," Weireter said. "It's the repetitive practice of the motion that counts."

Yet haptics plays a large role in the center's debridement system. Debridement is the system for cleansing wounds that are too large to stitch closed. Medics, paramedics,

and nurses must learn to clean the wound and remove dead tissue, glass, and other foreign objects to prevent gangrene and infection.

"It's really a simple procedure," said Hector Garcia, a Virginia Modeling Analysis & Simulation Center research scientist. "If you can use a fork and knife to cut chicken, you can do this. But we don't want to have to take a medical doctor's time away from other tasks to teach this simple procedure."

The debridement system attempts to replace a physician with instructional materials and simulations. First, a virtual instructor describes different types of wounds and lacerations. Then it shows videos of procedures. Finally, the system walks the student through the cleansing of a wound containing glass shards or other objects by using a three-dimensional simulation projected onto a large reflective screen.

No one would mistake the virtual wound for the real thing, but it has enough fidelity to give students practice. "They grab the grasper-type tool affixed to the end of the robotic arm and use it to clean the wound," Garcia said. "The robot has six degrees of freedom and the ability to provide resistance or deny movement in any direction."

As the robotic arm moves, it interacts with a computer-generated wound. The computer represents the skin's surface as a mass-spring model, a mesh of nodes connected by lines. Each node has a mass associated with it. The lines between them act like springs. When the instrument touches a spring, the model calculates the resistance based on the mass of the node and the resilience of the spring. This calculation determines the haptic resistance of the robotic arm.

"Some surfaces deform and bounce back when pushed," Garcia said. "Others offer more resistance. It doesn't behave like real tissue, but our model is based on a more precise and computer-intensive model of how skin deforms. It's close enough to give the illusion of skin, but simple enough to run in real time on our computers."

According to Weireter, "It's a great device, intended to teach real novices how to clean up a sophisticated wound so you can move the patient safely." Weireter and other team members are now looking at ways to make the debridement simulator generate a broader variety of wounds and teach students to monitor them for signs of

infection after treatment.

Virtual Operations

The virtual operating room creates even more complex interactions between real and virtual space than the debridement system. The space itself is a combination of the real and the virtual. High-intensity lights glare down on a mannequin lying on the operating table. The room's walls display virtual monitors, instruments, and a transfusion kit. Two live students share the room with simulations of other medical professionals.

"The room combines psychology and engineering," Scerbo said. "If you look at advances in safety made in other high-risk domains—aviation, nuclear power, military operations—they were achieved by people who understood the entire environment in which they perform. They understood their tasks, their tools, and the role of their coworkers.

"Doctors and surgeons don't perform individually. They perform with other doctors and nurses, with instruments and displays, and often with lack of sleep. They may go in for a 90-minute procedure, but wind up standing through a four- or five-hour operation."

The new technology promises interactions that will blur the distinctions between reality and models in virtual space.

Decision-making and communications are critical in that environment. "First-year surgeons learn procedures, but then they have to understand the interaction of drugs, operating room conditions, and patient status," Scerbo said. "If something unexpected happens, they have to be able to handle that, too."

Today's surgery simulations teach only procedures, he noted. None shows doctors the context in which they have to perform. Scerbo's goal is to take existing skills-oriented simulations and then add operating room interactivity.

"What we've done," added Weireter, "is put a simulation that teaches technical skills into an interactive

environment, where the other people in the room are not real people but virtual images. We're not going to teach you to do the operation, but how to act with other people so you know how to interact when catastrophes occur. Instead of making it up at the line of scrimmage, we're going to drill team behavior so that when something happens, it's no big deal because we've prepared for it."

As the virtual operating room evolves—and this may take years—it is expected to drill students and residents in critical thinking and communications skills. They will see more and more varied emergencies than the cases that come through the hospital doors when they are on shift. They can also schedule virtual team practice at their own convenience.

Into the World

Equally important, the virtual operating room gives human factors researchers a tool to study how and why surgeons make mistakes. "We can look at the sources of errors that creep into procedures and design countermeasures," Scerbo said. "We can build better systems that match the capabilities of human users without overloading or underloading them."

Scerbo, Weireter, and Garcia freely admit that virtual surgery is still in its infancy. Many commercial systems have design flaws or leave out critical steps. A simulator that's designed to teach how to draw blood, for example, doesn't let doctors or nurses feel an arm to get a sense of a vein's location. "People who trained on that system did worse when they went to take blood than those that trained conventionally," Scerbo said. "It was like learning to fly on a flight simulator that doesn't let you fly in the wind."

Yet simulation systems have already scored victories. Several years ago, members of the U.S. military's Special Forces challenged Weireter to use his system to solve a battlefield problem. "The medics we trained performed great in well-lit rooms with elevated operating tables," he recalled. "But they didn't know how to perform when people were shooting at them in the dark.

"So we took medics and put them in an environment where they had to keep their heads down or they were shot by a sniper. When they mastered that, we turned off

the lights so the only light they had came from explosions. We showed we could train them to perform in that environment, to focus on what's important, and keep their heads down so they didn't get shot."

Those medics are now saving lives in Iraq. They are not succeeding because their medical skills are different from the medics who trained before them. Instead, they save lives because they understand the context in which they must put their skills to use.

One day, thanks to medical and surgical simulations, that might be true of all doctors and nurses.

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A Virtual Operating Room for Context-Relevant Training

Mark W. Scerbo [1] Lee A. Belfore, II [1] Hector M. Garcia [1] Leonard J. Weireter, Jr. [2]
Michael W. Jackson [1] Amber Nalu [1] Emre Baydogan [1] James P. Bliss [1] Jennifer Seevinck [1]
[1] Old Dominion University
[2] Eastern Virginia Medical School

A fully immersive virtual environment simulating an operating room is described. The Virtual Operating Room (VOR) is a platform that integrates procedural medical simulators into a coherent, context-relevant training environment. Trainees interact with a surgical team comprised of real and/or virtual team members (e.g., attending surgeon, anesthesiologist, scrub technician, and circulating nurse). All characters are defined by their procedural knowledge and personality. The interface capitalizes on natural interactions and is largely driven by voice recognition and text-to-speech software. A custom designed controller manages the VOR functionality, rendering platform, speech recognition, and text-to-speech generation modules. The VOR allows instructors and researchers to simulate the physical and social context in which surgical procedures are performed. The VOR can be used to train surgical teams and address issues in judgment, decision making, team dynamics, and interpersonal skills. Most importantly, the VOR allows medical teams to train the way they operate without putting patients at risk.

INTRODUCTION

Medical Simulators

Simulators for training medical procedures have been commercially available only within the last 5-6 years; however, the number of systems on the market and procedures addressed by those systems is growing (Dawson, 2006; Rall & Gaba, 2004; Satava, 2001). Today, surgeons, doctors, nurses, medics, and EMTs have access to full body mannequins and virtual reality trainers for training procedures in trauma, anesthesiology, and laparoscopic surgery.

Several key events have transpired recently that are driving the need for and development of simulation-based training of medical procedures (Scerbo, 2005). First, in 1999 the Institute of Medicine released a report indicating that human errors result in nearly 98,000 deaths annually in hospitals (Kohn, Corrigan, & Donaldson, 1999). One of the primary contributors to error cited in the report was excessive fatigue due to resident work schedules that routinely exceeded 100 hours per week. Second, and in response to the IOM report, the AMA's Accreditation Council for Graduate Medical Education set restrictions on the working hours of residents (2003). Unfortunately, the policy also restricted opportunities for patient contact forcing medical educators to search for alternative means for training, including simulators.

Long before the IOM report was published, Moray (1994) argued that errors in healthcare were a systemic problem. He stated specifically that from the micro to the macro level, each of the following factors contributes to errors: design of physical devices, ergonomics of the OR and equipment, individual performance, team performance, organizational policies, legal and regulatory issues, and societal and cultural pressures.

At present, most current medical simulators target specific procedural skills (e.g., airway management, laparoscopy). Although training on these simulators is an ideal way to practice difficult procedures, these systems are not designed to address errors resulting from inappropriate equipment design, poor judgment and decision-making among team members, or changes in organizational policies. Therefore, an alternative approach to training is needed to address other sources of error in the healthcare system.

Virtual Environments

Virtual environments (VEs) have been proposed for training in a variety of contexts including teams, leadership skills, mission rehearsal, and navigational

skills (Cohn & Patrey, 2001; Knerr, Breaux, Goldberg, & Thurman, 2002). Recently, Scerbo and his colleagues (Scerbo, Bliss, Schmidt, Hanner-Bailey, & Weireter, 2005; Schmidt, Scerbo, Bliss, Hanner-Bailey, Garcia, & Weireter, 2006) used a VE to examine the performance of surgical skills under simulated combat. These researchers observed that even simulated conditions affected the performance of both medical students and residents. The researchers argued that VEs are a valuable tool for medical training because they offer a safe environment for studying a range of medical procedures performed under a wider variety of contexts. Given the concerns over patient safety outlined above, a new VE was developed to study contextual factors that affect surgical procedures in the operating room.

THE VIRTUAL OPERATING ROOM

The present paper describes an immersive Virtual Operating Room (VOR). The VOR is modeled after a standard OR and outfitted with both real and virtual instruments as well as commercial medical simulators. The VOR does not replicate existing medical simulation technology, but instead provides the OR context in which to study performance. Further, participants can interact with one another in teams composed of humans or virtual agents (see Figure 1). The focus of the present paper is on the tasks and interface used in the VOR. Additional details on the underlying architecture can be found in Scerbo et al. (2006).

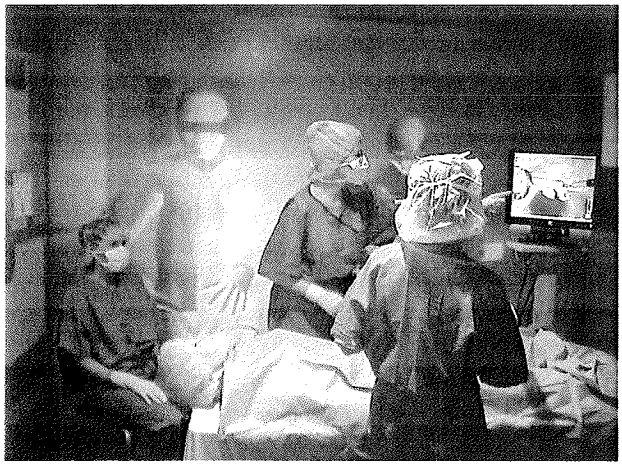

Figure 1. Participants Performing Laparoscopic Surgery in the Virtual Operating Room.

Surgical Procedure

The surgical procedure selected for initial development and training was a laparoscopic cholecystectomy (gall bladder removal). This procedure was chosen because it is fundamental to any surgical training program and there are several commercial simulators that support it.

To begin, a genuine cholecystectomy procedure was videotaped to establish the roles for each participant, the activities performed by each participant, and the environmental layout. The full procedure was separated into three primary phases (anesthesia induction, surgery, and emergence from anesthesia). Cognitive task analyses were then performed to establish the roles, responsibilities, and activities for each member of the surgical team. A timeline was created depicting the activities for each step of the procedure for each team member. The initial description represented the procedure performed under ideal conditions. Next, critical complications were identified and integrated into this basic structure. The task analysis resulted in 35 key steps for the anesthetist and 11 key steps for the surgeon. The resulting workflow was then used to create a framework for coordinating movements and dialogue among the virtual agents (see below).

The Operating Room Environment

The physical environment modeled in the VOR was created using 3D Studio MAX 6.0. The models were then exported to Maya 5.0 and then to Virtools to be rendered in the virtual environment. The simulation is rendered in a CAVE, with Virtools providing the necessary libraries to export the visualization to CAVE environment.

The Surgical Simulator

The choleycsytectomy procedure was performed using the LapTrainer system by Simulab, Inc. (Seattle, WA). The LapTrainer is a commercial laparoscopic simulator that uses plastic and rubber models of the abdominal cavity including the stomach, liver, and gall bladder. A replaceable gall bladder is attached to a retracted infundibulum with Velcro and can be ligated with genuine laparoscopic instruments. The system also uses a small video camera housed in the abdominal cavity to display the user's actions on an LCD screen. For this scenario, the patient's chest and head were inactive and represented by a mannequin.

Virtual Agents

A typical surgical team is comprised of an attending surgeon, operating surgeon, anesthetist, scrub technician, and circulating nurse. In the present scenario, virtual agents were created for only the attending surgeon, anesthetist, and circulating nurse.

Each virtual agent was defined by a unique personality and knowledge structure. Thus, unlike most task analyses where several experts are often interviewed to distill a common underlying knowledge structure, in our analyses, differences among experts were preserved. Thus, the idiosyncratic procedural knowledge that distinguished our experts was captured and used to define unique characters.

In addition, the virtual agents each have their own personalities based on the Big Five Model, also known as the Five Factor Model (McCrae & Costa, 1990). According to this model, personality can be described by five factors: agreeableness, conscientiousness, extraversion, neuroticism, and openness. More specifically, the Abridged Big-Five Circumplex (AB5C) model was used as a guide to create unique personalities that differed along the five dimensions (De Raad, 2000). Further, Hill, Williams, & Bassett (2002) developed a scoring list containing three hundred personality adjectives and their relationships to each of the Big-Five categories. These scores were used to modify the manner in which agents responded as well as characteristics of their speech (e.g., pitch, volume, speed, ETC.; see below) to convey differences in personality. Thus, for example, our "arrogant" agent was defined by characteristics reflecting high extraversion and conscientiousness, low agreeableness, and moderate emotional stability and culture.

Agent Movements

Virtual agent models were rigged with a 'bone' skeleton structure. This included the development of skeletal representations of the hand to enable finger animation as well as motion capture of hand movements, providing additional realism. Subsequent to rigging, the agent models were skinned to enable smooth deformation of model geometry during bone deflections. Skeleton solvers include inverse and forward kinematics. Skeleton creation and skinning were done in Maya; rigging, animation and motion capture were done in Motionbuilder. A Cyberglove was used to capture the hand movements in real time.

Analyses of genuine laparoscopic procedures revealed that once the operation begins, there is little gross movement among the team members. Thus, outside of a few animations for negotiating the OR environment, sequences were primarily limited to head and hand movements. Animation keyframes and motion capture data were plotted onto the character skeletons in Motionbuilder. Agent models and their animations were imported into the Virtools environment. Body parts were scripted to track certain objects in the scene (e.g., enabling a surgeon agent's hand to follow the location of a trainee controlled instrument). Animation sequences were called using a message passing tool triggered by key words from the voice recognition software (see below).

Communication Interface

The trainees communicate with the virtual team members using wireless headset microphones. A custom application was created to recognize the speech commands and send them to the simulation controller. The speech recognition application was created using the Dragon Naturally Speaking Client SDK version 9, Medical edition from Nuance Communications, Inc., (Burlington, MA). In addition, the speech recognition application receives commands from the simulation controller that moderates the functionality of the application. For example, speech recognition must be disabled during the text-to-speech events to prevent the system from attempting to inappropriately respond to the computer-generated speech. Accuracy is enhanced by recognizing similarly sounding words/phrases that may be recognized instead, and including these as proxies for the desired words/phrases.

The character's voices were generated using several Microsoft SAPI 5.1 text-to-speech engines such as NeoSpeech Kate, NeoSpeech Paul, Cepstral Miguel, and Cepstral Marta. The text-to-speech (TTS) XML texts are processed by the TTS controller of the simulation system functioning as a separate portable application using UDP packets to communicate with the simulation controller.

Performance Assessment

Performance is assessed in several ways. The timeline provides a basic framework for verifying the steps in the procedure. Speech utterances are compared to steps along the timeline and provide input for real-time performance feedback offered by the virtual agents. In addition, speech commands are logged, time-stamped, and stored in a database to be analyzed later along with

the individual tasks. Accuracy metrics are obtained by comparing the order and type of tasks attempted by the trainee to the script used to drive the scenario. The speech database is combined with traditional event logging software used in video analysis systems to support a more comprehensive assessment of individual performance and performance aggregated across team members.

Initial Results

A pilot session was conducted with a third-year surgical resident who had experience performing the laparoscopic cholecystectomy procedure, but who was unfamiliar with the VOR. The surgeon performed the voice recognition initialization training and then entered the VOR. He was told to play the role of a resident performing the procedure. He was given a set of laparoscopic instruments, introduced to his surgical team, and given the microphone headset to communicate with his virtual teammates.

The surgeon began the session by identifying the patient and asking the anesthetist about the patient's status. He then performed the procedure informing the virtual attending surgeon of his progress along the way. Because no details about the sequence of tasks were given to the surgeon, he occasionally used alternative terminology or omitted utterances that were expected. It was also observed that some of interactions between the surgeon and the agents differed from the sequence used to generate the timeline. Thus, it was determined that some of the agent responses would have to be available throughout the entire procedure. Hence, some of the simulation transitions had to be triggered manually.

The data recorded from the pilot session are being used to improve the responsiveness of the system. Additional testing is required to identify the most common patterns of interaction to generate a more flexible sequence of tasks and broader speech recognition lexicon.

CONCLUSION

The VOR represents a unique approach to team-based surgical training. First, trainees can interact with virtual agents representing different members of a surgical team, all of whom are modeled on experts. Consequently, medical students, surgical residents, and nursing students can train for their specific roles on a surgical team and avoid having to role play the parts of other team members.

Second, the VOR does not require trainees to become proficient with a simulator's interface (or those of several simulators). Because emphasis is placed on speech recognition, trainees benefit from more natural interaction among the team members and virtual agents.

Last, the VOR provides tight control over the training environment. In many live exercises, the comments and actions of instructors and trainees can vary across groups undergoing the same scenario. The VOR provides greater consistency in training experiences because the environment is computer-based and the scenarios, virtual agent actions, and agent dialogue can be scripted. Consequently, instructors can exercise more control over those aspects of scenarios they wish to preserve and those they choose to let vary across training exercises.

In sum, the VOR provides a unique simulation-based training experience for medical personnel. It can integrate all forms of medical simulators into one coherent educational experience and facilitate training at both the individual and team levels. The VOR can also provide a laboratory for studying changes in organizational policies, regulations, and individual/cultural differences in the OR. Perhaps most importantly, the VOR allows medical teams to *train the way they operate* without putting a single patient at risk.

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making inroads

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Source: JACOB GEIGER

By Jacob Geiger The Virginian-Pilot

As the Department of Defense poured millions of dollars into new **modeling** and **simulation** contracts over the past decade, much of that money - as well as thousands of jobs - came to Hampton Roads.

The Virginia **Modeling**, Analysis and **Simulation** Center estimated earlier this year that the industry brought nearly $365 million into the region's economy in 2007 and accounted for 4,420 jobs.

The average salary of those jobs was $82,733 - more than double the Hampton Roads average of $38,428, according to the **simulation** center , which is affiliated with Old Dominion University.

Researchers and economic development officials now hope that **modeling** and **simulation** will grow beyond defense work, especially in the fields of medicine and transportation .

Researchers at ODU and Eastern Virginia Medical School have developed innovative ways to treat patients and train new doctors.

Modeling experts also are looking for ways to study hurricane evacuation to help transportation and logistics companies negotiate the region's crowded roads and tunnels while preparing for a major expansion of the port.

"We've set up research clusters in areas of medicine, transportation and other areas," said John Sokolowski, director of research at the **simulation** center. "We think that's the future growth of **modeling** and **simulation**, particularly over the next 10 years."

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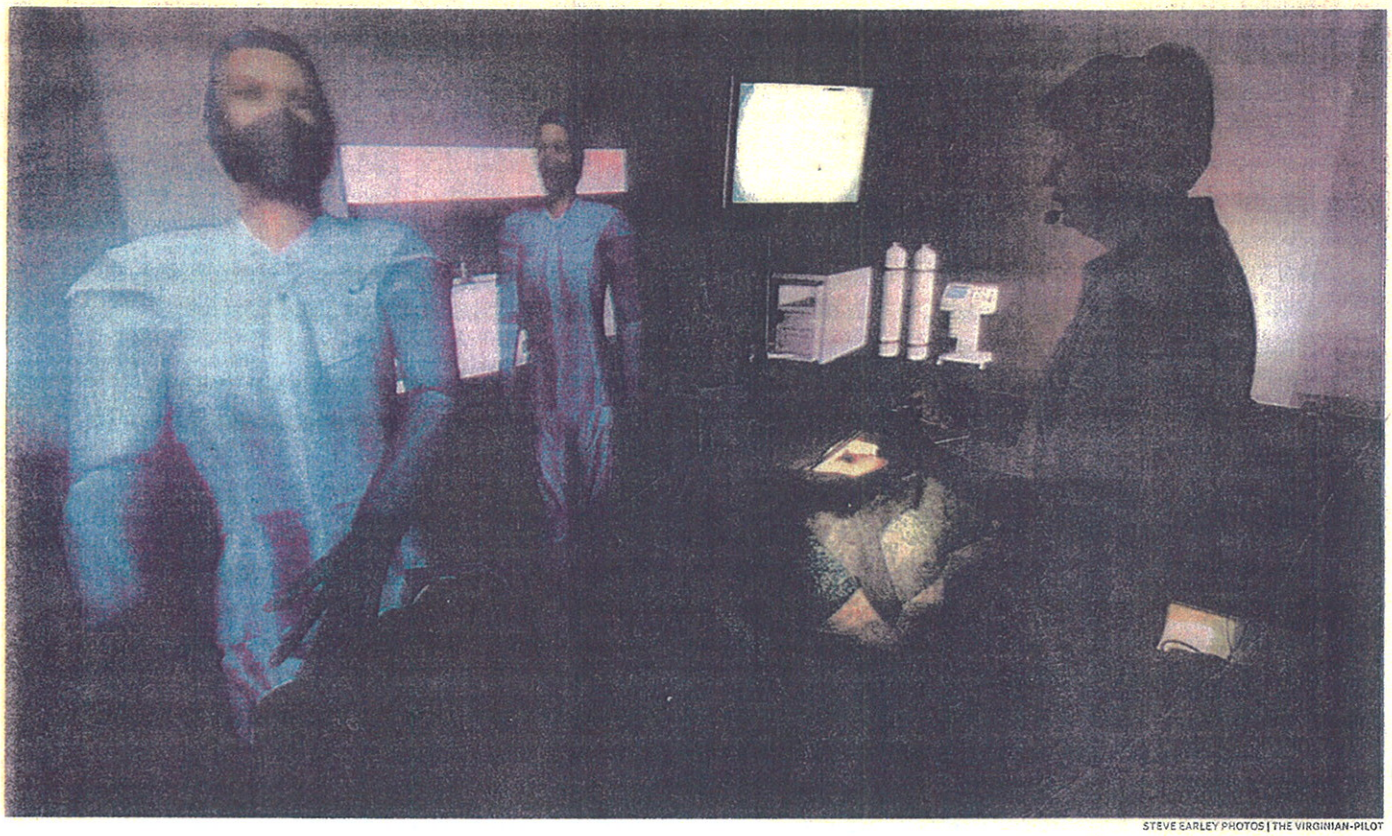
Sunday

MODELING AND SIMULATION

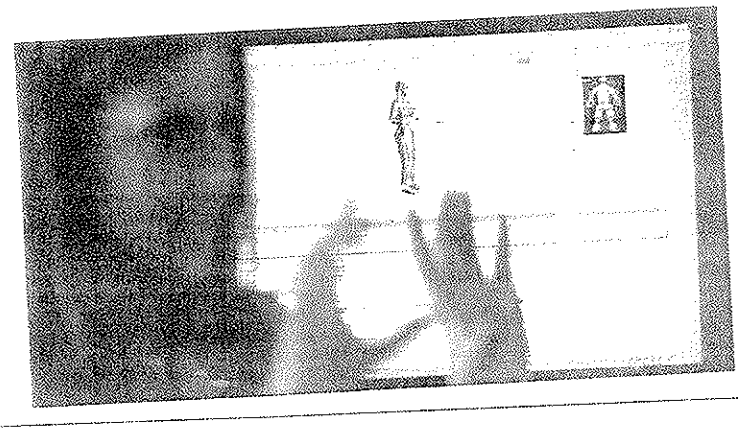


STEVE EARLEY PHOTOS | THE VIRGINIAN-PILOT

VIRTUAL SURGERY
VIRTUAL DISASTER
VIRTUAL TRAFFIC

REAL OPPORTUNITIES FOR HAMPTON ROADS

Sure, it sounds a little geeky, but modeling and simulation just keeps growing locally, and the lucrative industry is ever-so-slowly starting to find some promising commercial applications.



Psychology professor Mark W. Scerbo demonstrates how medical students would perform simulated surgery in Old Dominion University's virtual operating room.

Doctorate student Liz Newlin explains how she creates avatars to represent medical characters.

The Virginia Modeling, Analysis and Simulation Center, an ODU research hub, will soon move into a new $11 million facility off Va. 164.

JOHN H. SHEALY III | THE VIRGINIAN-PILOT

NEAR A 'TIPPING POINT' LOCALLY? OFFICIALS HAVE MIXED VIEWS

By Jon W. Glass
The Virginian-Pilot

IN A DARKENED ROOM at Old Dominion University, Mark Scerbo spoke a command into a headset. Instantly, the space morphed into a hospital operating room.

A simulated surgical team beamed onto the walls. The 3-D team, outfitted in blue scrubs, included a testy attending surgeon given to such sarcastic zingers as: "Your incompetence is mind-boggling. Please state your procedure." A beeping heart monitor and a patient's rhythmic breathing added realism.

Scerbo, an ODU psychology professor who studies human use of technology, thinks this virtual operating room could transform the way doctors train to become surgeons.

"For the first time, this opens up the possibility of doing alternative forms of training without putting a patient at risk," he said.

For Hampton Roads, the significance extends well beyond medicine.

Local officials say it's the kind of cutting-edge work under way here that could turn the region into a national magnet for business in computer-based modeling and simulation.

See NEAR, PAGE 3

Continued from Page 1

Besides bragging rights, the move to grow modeling and simulation could add hundreds of millions of dollars to the region's economy and create jobs that pay far higher than the average local salary.

While the military remains the industry's No. 1 customer, university researchers and some private companies now use computer simulations to try to solve problems encountered in medicine, homeland security, transportation planning and education.

There's also efforts to tap into game-based technology to lure the Xbox and PlayStation generation into math and science careers – considered crucial to maintaining the nation's competitive edge.

This week, the region will showcase such non-military work at the ModSim World Conference and Expo, a three-day event starting Tuesday at the Virginia Beach Convention Center.

Local officials said the homegrown conference, the first of its kind and more than a year in the making, could draw 500 participants.

They hope it will help brand the region as a hotbed for modeling and simulation – and show that work being done here is not all about defense.

The gee-whiz factor of virtual displays should be high. There will be sessions with panel members from across the country and the globe. They will explore the use of high-tech computer tools for such things as managing port and air traffic, improving the response to disasters and training doctors in laparoscopic surgery.

Officials aim to demystify the subject to a public inclined to relegate it to computer geekdom.

"There will be plenty to do and see and touch," said Bob Sharak, director of special projects for the Hampton Roads Partnership, which helped organize the event. "We thought it was good to have a conference that would sort of put us on the map."

Since the late 1990s, the nation's top defense contractors have set up shop in Hampton Roads, drawn here to work with the Pentagon's Joint Forces Command.

Along a bustling corridor in northern Suffolk, dubbed Sim City, the military command uses computer models and simulations to test war-fighting technologies and run virtual battlefield exercises.

It's been good business. A 2004 study showed that the modeling and simulation sector pumped more than $400 million and 4,000 jobs into the local economy. The high-paying jobs are the kind city leaders salivate over – an average salary then of $59,405, nearly two-thirds more than the region's $34,918 average.

As a measuring stick, though, those numbers pale beside Orlando, Fla., long regarded as the industry powerhouse. A 2003 study showed that modeling and simulation generated around 17,000 jobs and $2.5 billion in metro Orlando.

Want to go to ModSim World?

Registration is required for the three-day event starting Tuesday at the Virginia Beach Convention Center.

A one-day pass with access only to the exhibit hall is $75.

The daily rate to attend seminars, plus breakfast and lunch, is $125.

Special military, government, teacher and student rates are available for all three days.

For details, go to www.modsimworld.com.

Defense work is heavy in Florida, too, where contractors design training simulators for driving tanks or flying fighter jets, for example. But the entertainment industry there, including Universal Studios, Disney and electronic-game makers, adds diversity.

Even so, Russ Hauck, executive director of the Orlando-based National Center for Simulation, said Hampton Roads has become a "significant player."

"If you want to view it as a horse race," Hauck said, "generally people have looked at us as No. 1 and Hampton Roads as No. 2, and coming on fast."

That may be so, but local officials have mixed views on how far modeling and simulation has advanced here beyond its military roots.

Some, like Jones Hooks, president and chief executive officer of the Hampton Roads Economic Development Alliance, say the commercial industry is still emerging.

Over the past five years, Hooks said, the alliance has spent around $300,000 pitching the region to modeling and simulation businesses. So far, the marketing effort has snagged only two companies – a defense contractor and a games-based technology firm. This month, the alliance is trying again at a modeling and simulation conference in London.

"I think we're still trying to build our case and position Hampton Roads as a leader," Hooks said. "A lot of things are beginning to come together, it just takes a while. Our expectations are not to make mega announcements; we're building awareness."

Others see the current mix of businesses, academic researchers and government interest reaching a critical mass.

"I think we're at the tipping point where we're getting ready to explode," said Bob Harper, a program manager for Northrop Grumman Corp. who works at Joint Forces Command. "If you look at north Suffolk, you can see the tremendous impact it has had, and it has the potential to do that for all of Hampton Roads."

In the past 10 years, the influx of defense contractors has turned the Harbour View section into Suffolk's largest office submarket, said Tom O' Grady, the city's economic development director.

Counting the military command's leases, more than 1 million square feet of office space has been built and occupied there. Defense contractors, including Lockheed Martin, Raytheon, SAIC and General Dynamics, are in about 350,000 square feet, O'Grady said.

That growth has attracted new hotels, restaurants and shops. And there's more coming, including a new technology park that straddles Suffolk and Portsmouth.

The Virginia Modeling, Analysis and Simulation Center, an ODU research hub known as VMASC, will begin moving this month into a new $11 million facility in the park, off Va. 164. The 60,000-square-foot building, nearly triple its current space, "will give us a phenomenal capability," said VMASC executive director Mike McGinnis.

Since opening in 1997, VMASC has spun out three start-up businesses. One, WernerAnderson Inc., has licensed technology developed at the center that models crowd behaviors. Company founder Eric Weisel, a former Navy submariner, earned a doctorate in modeling and simulation from ODU – one of a handful of universities to offer such a degree.

The behavior model, Weisel said, was designed for the military to analyze tactics of dealing with crowds, such as hostile, rock-throwing mobs. However, Weisel said, the model could be used by civilian police and emergency responders for training in disaster situations, and "we're excited about the possibilities."

In five years, the company has grown from a one-man operation to 10 employees and parlayed first-year revenue of $30,000 into business expected to top $1 million this year, Weisel said. Grassroots companies like his and not large corporations, he said, likely will spur further expansion of modeling and simulation in the region.

Ultimately, the region's goal to become a national nexus for modeling and simulation will depend on its ability to expand into new markets, officials said.

"Almost all the companies here have some military realm, because that's the one constant. We're really just starting to make some progress in other areas," said Mike Robinson, VMASC's director of programs advancement.

One of the most promising prospects seems to be in medicine.

Last month, a joint venture between Eastern Virginia Medical School and ODU scored its first commercial success. A Texas company, Cardionics, licensed the research team's technology to a virtual pathology stethoscope. It plans to market the device as a tool to help medical students learn how to detect lung and heart diseases.

The virtual operating room, still under development by EVMS physicians and ODU scientists, represents another project with commercial potential.

Scerbo, the ODU psychologist, said the operating room could be sold to train surgeons. It also could be used as a research facility to test the effectiveness of medical simulators now being built by commercial vendors.

Using a variety of off-the-shelf software, local researchers programmed the virtual surgical team using voice-recognition cues to guide trainees through a gall bladder removal. The animated team includes an anesthesiologist, a circulating nurse and an attending surgeon, who zings a trainee who fails to ask the right questions or give correct answers.

Surrounded by the sights and sounds of an operating room, trainees use real surgical instruments and "operate" on a commercially available simulator that models a gall bladder. The purpose, Scerbo explained, is to mimic the social dynamics that might occur in a real operating room – and to eliminate errors on live patients.

If successful, it could draw medical manufacturing companies to Hampton Roads, Scerbo said, "opening up a whole new area for pilot-testing equipment" in an operating-room setting.

Armed with $6.2 million in federal and private grants,

> Generally people have looked at us as No. 1 and Hampton Roads as No. 2, and coming on fast."
>
> *Russ Hauck, executive director of the Orlando-based National Center for Simulation, comparing Hampton Roads and Florida*

EVMS researchers are working on a range of other modeling and simulation projects.

One examines the effects of cosmic radiation on the brain, in support of NASA's plan to send humans to Mars. Another focuses on early detection of breast and prostrate cancers. A third involves developing a chainsaw simulator to train relief workers who need the real thing after natural disasters.

With the national market in medical modeling and simulation expected to grow to $1.5 billion by 2012, the aim is to steer some of that business to Hampton Roads, said Don Combs, an EVMS professor and associate dean.

"Our goal is to carve out a niche that focuses on the world of practice and that is concerned about patient safety and health care," Combs said. "I think you're beginning to see results."

Across the region, other efforts to diversify beyond defense are under way. VMASC is working on several transportation-related projects, including a simulation to help planners manage the flow of trucks and cargo at the new APM Terminals Virginia in Portsmouth.

Also, a VMASC researcher is looking into ways that computer simulations could be used to teach algebra to high school students, said John Sokolowski, the center's research director.

Even defense contractors are fishing for ways to expand.

At the Center for Innovation, a $35 million facility Lockheed Martin opened two years ago in Suffolk, researchers are delving into homeland defense, port security and movement of freight, said Mort Forker, Lockheed's director of business development.

"There are so many potential customers and partners here," Forker said.

The ModSim World conference, boosters said, has been a regionwide collaboration, with some companies ponying up $25,000 to help sponsor it.

"We think it can be a springboard, so more people can see how this technology can be used in their everyday business, to help them do planning, to help them make better decisions," said Bill Younger, conference co-chairman.

Younger is an executive with Portsmouth-based Mymic, a modeling and simulation firm whose work has tripled in two years. A decade ago, he said, modeling and simulation was "like a foreign language" locally.

"Now, it's amazing," he said. "We've come a long ways very quickly. It's going to be a growth area for this region."

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