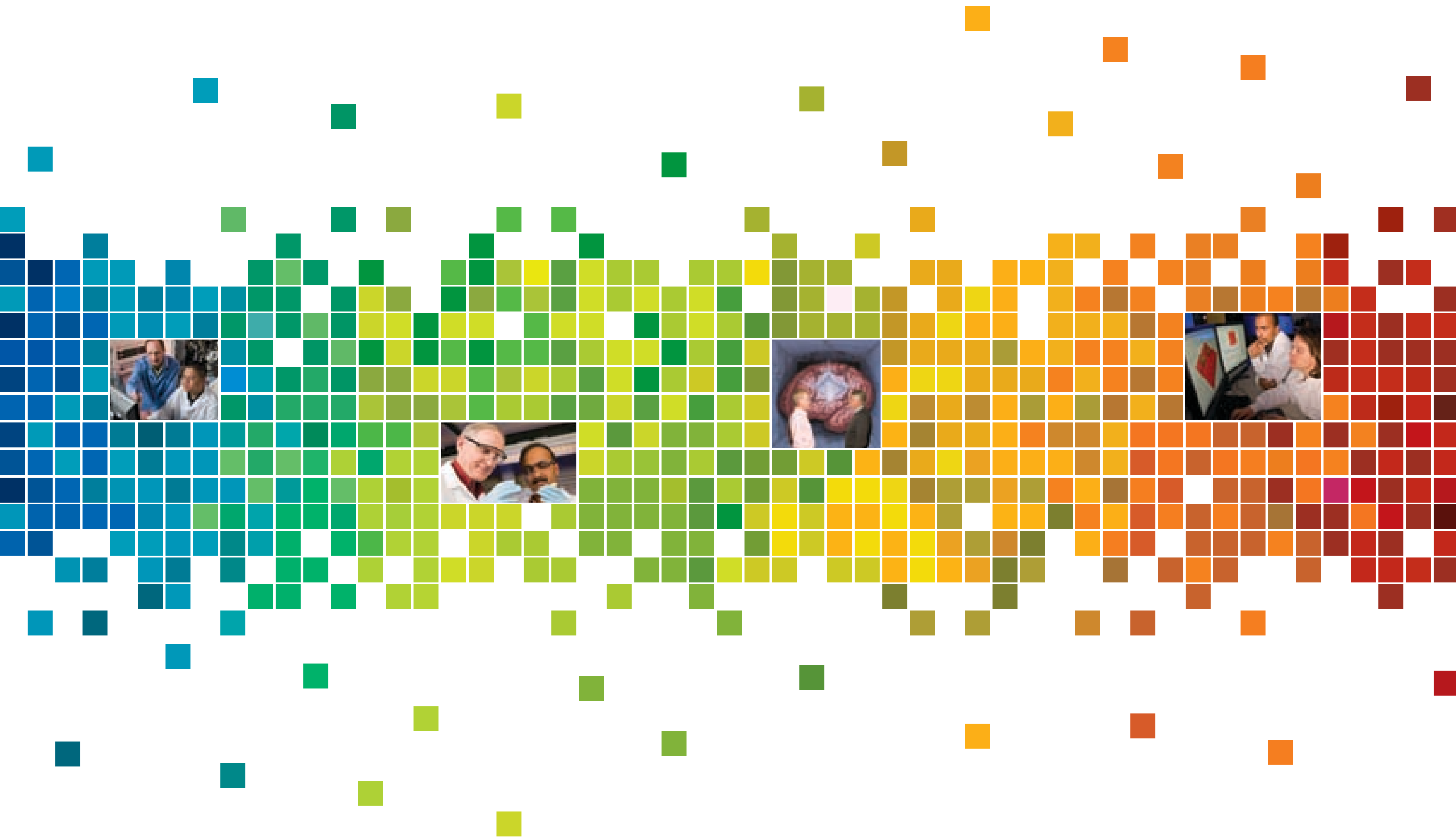
VCU School of Engineering

Virginia Commonwealth University

Volume three



collaboration

Institute for Engineering and Medicine

FROM THE DEAN
VCU School of Engineering

Welcome to this special edition of the VCU School of Engineering research magazine. The theme for this issue is collaboration. The grand challenges of our age – security, environment, energy, and human health – require that many disciplines engage cooperatively and creatively to find cost-effective solutions. Henry Ford said that "Coming together is a beginning. Keeping together is progress. Working together is success." When collaboration is working, it is a wonder to behold.

The collaborations in this issue relate to human health. I invite you to read about the research of these talented groups, whose success owes much to their willingness to embrace partnerships across disciplines. Each vignette is a story of creative engagement with important problems by diverse teams of faculty, students, and staff. The power of the interdisciplinary team to solve big problems in novel ways has never been more evident than it is in these stories.

At the end of the magazine is a list of all of our engineering faculty and the areas in which they work. If you see links to your own work here, I encourage you to reach out to start that first important conversation that can lead to collaboration and to all the good things that flow from it.

—Russell D. Jamison, PhD

Published by
Virginia Commonwealth University
School of Engineering
P.O. Box 843068
Richmond, Virginia 23284-3068
Phone: (804) 828-3925
www.egr.vcu.edu

Editors:
Sarah McCollum
editor@capitalcitybooks.com
Naomi Crown

Graphic Design:
Steven Longstaff Creative

Photography:
Doug Buerlein
Illustration: Alex Meredith

CONTENTS

Volume three

Dr. Frank Gupton, interim director of the Institute for Engineering and Medicine

Institute for Engineering and Medicine

Bonds VCU Research Community

As scientists seek to discover the causes and cures for disease and translate their endeavors into improved health care, it is clear that a significant portion of future advances will come through interdisciplinary collaboration. The faculty of the VCU Schools of Engineering, Medicine, and Life Sciences are actively engaged in numerous collaborative research projects ranging from drug design and delivery, tissue engineering and bioinformatics to regenerative medicine and antimicrobial coatings. To foster and promote this type of translational research, a new facility has been established to provide cost-effective, shared resources for interdisciplinary research. This facility, dedicated to collaborations in engineering and medicine, is a state-of-the-art flex lab designed to accommodate a variety of project needs. The new research hub is strategically located in the Engineering West Hall on the Monroe Park Campus.

To effectively leverage the capabilities of this new asset, a chartered institute is being established to provide organizational structure for this facility. This institute will formally encompass, manage, and compliment the elements of bioengineering and biotechnology that currently exist at VCU. As a project-driven entity, the VCU Institute for Engineering and Medicine (VCU IEM) will make laboratory research space available for interdisciplinary projects that embrace new technologies in the pursuit of offering high-quality, affordable health care. The Institute will provide an environment that fosters the sharing of knowledge and resources to address the most challenging issues facing biomedical science and engineering.

Although this concept is new to VCU, similar facilities have been developed in the U.S. over the past decade, including Stanford's Clark Center and the Rensselaer Center for Biotechnology and Interdisciplinary Studies. These lab facilities are flexible and project-driven rather than faculty-driven in the allocation of space, whereby projects are typically tied to interdisciplinary funding. As projects change, faculty investigators within the proposed Institute will change along with the interior lab configurations.

One of the most important goals of the VCU IEM will be to promote interdisciplinary partnerships between the Medical and Monroe Park campuses. The primary objective of these collaborations will be to translate the basic research carried out at the VCU IEM into products, services, and procedures that will advance health care. From a broader perspective, the development of these partnerships within the VCU IEM will serve to link the two campuses at VCU to more effectively leverage and unify the collective research capabilities of the university.

Equipped for Inspiration

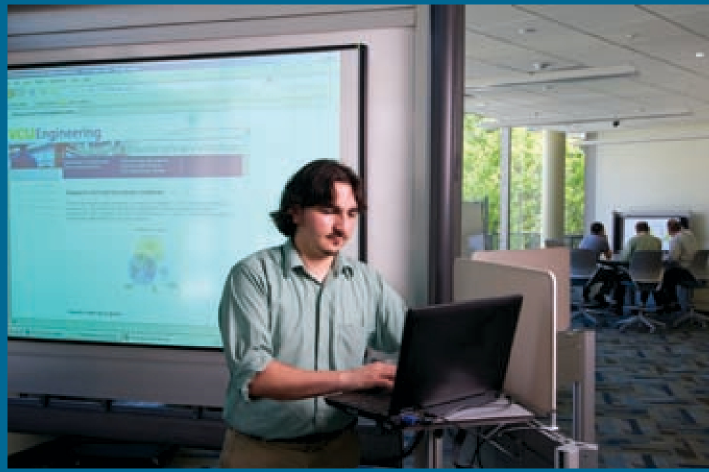
The common spaces in the Institute for Engineering and Medicine (IEM) are designed to inspire. Just outside the shared reconfigurable lab space, presentation and meeting areas hug the curve of the building, allowing for an unbroken line of sight from one end of the bow to the other.

These meeting areas provide researchers with the tools they need to accomplish the IEM's mission of sparking discussion, fostering creativity, and encouraging collaboration across the disciplines of engineering, medicine, and the life sciences.

Led by Caren Girard, the team at VCU Planning and Design worked with Creative, a workplace interiors and technology company, to create meeting spaces where people would be drawn to share information and ideas. Out of this collaboration emerged an innovative design.

The open layout promotes a form of visual eavesdropping that lets researchers in one meeting space see the data being presented by another group. People can quickly move back and forth between spaces—displaying information, asking questions, and exchanging ideas.

Frank Gupton, interim director of the IEM, sees the building itself as call to action. In this vision, researchers will exchange ideas in the common areas and then walk just a few steps into the lab where they can bring their ideas to life.



Between the upper and lower arcs, the IEM's common spaces can accommodate up to 12 groups. The meeting areas are separated not by physical walls, but by special "walls of silence", which prevent the space from becoming too noisy.

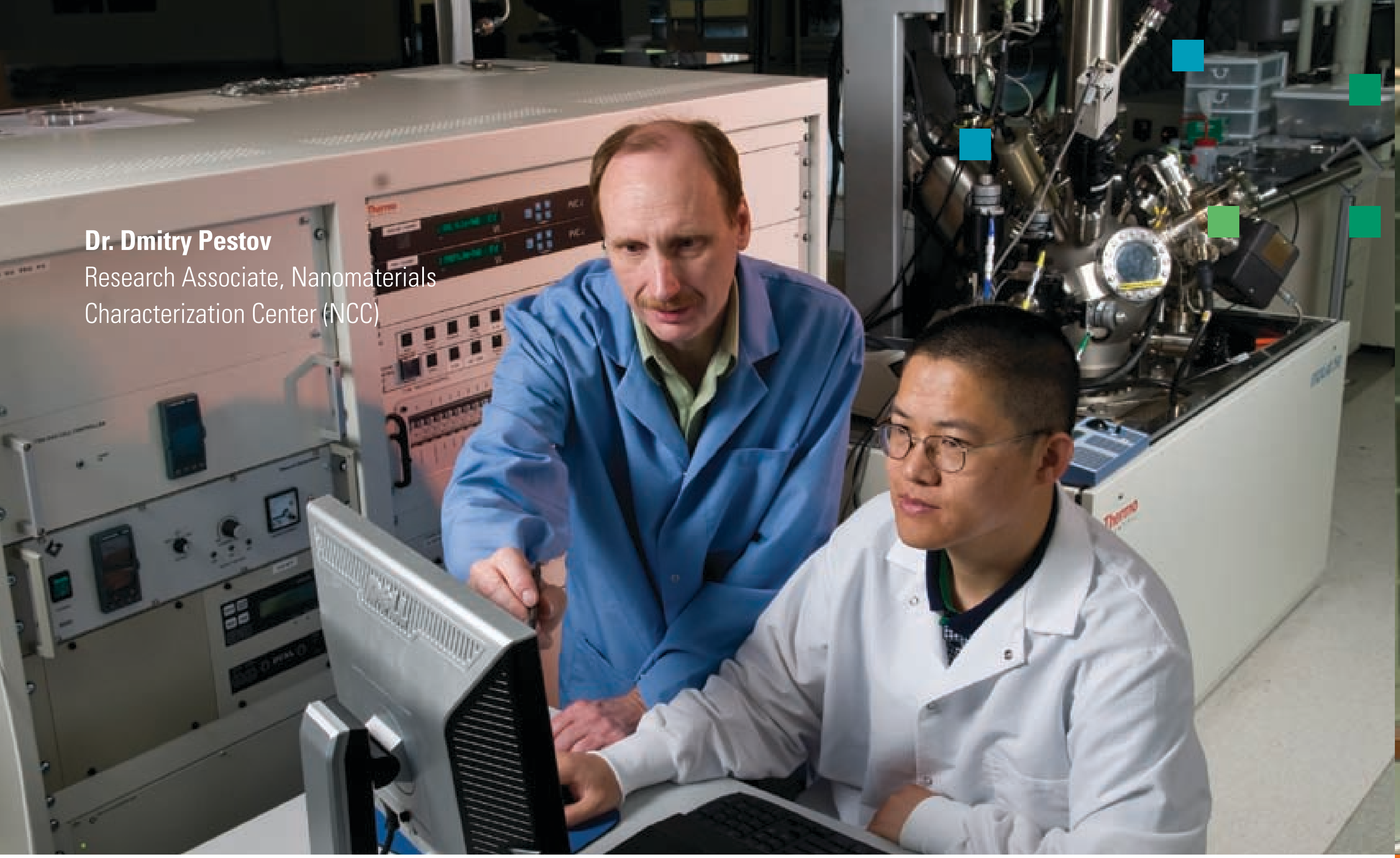
Each area is equipped with state-of-the-art, intuitive technology that helps teams share information quickly and easily.

The PolyVision Eno Board is a smart board that allows researchers to manipulate the material on a white board using both a computer (dedicated to the space) and a stylus that looks like a dry erase marker. Users can project onto the board, write on it, and save their work to a file or post it on a website.

Mediascape is an example of a furniture solution integrated with technology. Using a VGA cable, each scientist can plug his or her laptop into one of several "pucks" that splay out from the conference table like tentacles. Then, with only a light tap of the appropriate "puck," users can switch displays. This tool supports collaboration and communication by providing instant access to digital information.

The Polyvision CopyCam makes an exact copy of the images drawn on a dry erase board and then allows researchers to print those images or save them to a USB storage device so that they can be exchanged, edited, and disseminated after the meeting's conclusion.

According to Gupton, "The IEM is built on the idea that innovation occurs at the interface of different disciplines." Combining the skills of faculty in traditional disciplines leverages VCU's research capabilities, and since only a handful of other schools across the country have similar facilities, the IEM provides VCU faculty and students with a unique opportunity to create and build on cross-disciplinary areas of strength.



Dr. Dmitry Pestov
Research Associate, Nanomaterials Characterization Center (NCC)

Small Scale, Big Ideas

in the Nanomaterials Characterization Center

At the Nanomaterials Characterization Center (NCC), my position is multifaceted. I manage equipment, work with faculty and graduate students on various research projects, and interface with industry and government clients.

Last summer, the NCC received an equipment grant that brought the center to the cutting edge of nanoscience and allowed faculty and students to conduct research that will greatly expand knowledge in the field. The culture of academia is one of sharing knowledge and resources, so this equipment will not only further ongoing research efforts at VCU, but it will also further studies at a range of universities and businesses.

Some of the newly acquired pieces of equipment include a Hitachi SU-70, a scanning electron microscope equipped with Nanometer Pattern Generation System (NPGS) for e-beam nanolithography; a VEEECO ICON AFM, an atomic force microscope with advanced processing technology; and a ThermoFisher ESCALAB 250, an instrument for surface analysis equipped with XPS, AES, ISS, and UPS spectrometry and XPS imaging.

With the NCC's acquisition of so many complex, sensitive instruments comes great responsibility and great opportunity. Each of these instruments is very versatile, and one of my primary roles in the NCC is to help users to learn both the capacities and limitations of the instruments.

Another part of my mission at the NCC is to discuss the results of experiments with students and faculty to discover new ways of making nanomaterials and nanodevices. Through research at the NCC, students are exposed not only to the current conditions of engineering science but also to desirable future technologies.

In addition to working with our students and staff, I assist customers from industry and government agencies who are doing experiments with their materials in the NCC. Some recent projects include collaboration with NASA to examine materials used in the space industry and work with the Virginia Museum of Fine Arts on stained glass restoration.

Periodically, students and teachers from high schools in the greater Richmond area visit the NCC, and I show them our equipment in action. Such visits are always filled with fun and delight. We hope that visiting the NCC will inspire these young people to become our future students.

On the move

to Prepare Institute Laboratories

Cindy Lovelace
Laboratory Manager, Department of Chemical and Life Science Engineering

In helping the faculty prepare to move into the new Institute of Engineering and Medicine (IEM), I have been coordinating with them to assess and meet their needs and find solutions to their problems.

My position asks me to be a generalist—a jack of all trades. I identify vendors for purchasing supplies, coordinate with faculty members and physical plant to determine the placement of equipment and even figure out how to get equipment up the stairs, around the corner, and into the room.

In helping to set up the IEM, I've been asking faculty a multitude of questions: What are you using the space for? How much power do you need? How should one work space flow into another? I'm thinking about the needs of individual research groups, but I'm also considering the space as a whole. For instance, how far from a loud, vibrating machine do we need to place a sensitive scale?

The use of the space should always dictate the configuration of furniture and equipment, and that's part of what's so exciting about the IEM. The open modular laboratory space features state-of-the-art equipment and adjustable, reconfigurable research spaces. Overhead utility modules make a host of utilities (electricity, internet connections, different gases, and purified water) accessible to researchers regardless of the room's configuration. In the past, resources and efforts were sometimes duplicated. The open lab makes sharing ideas and equipment easier and more transparent.

The facility was built for our engineering and medical faculty to work together to inspire further collaborations across disciplinary boundaries. The lounge-style areas just outside the lab provide a space for collaborative brainstorming and presentations. The biggest challenge here will be to keep our dry erase marker supply stocked!

Saving Lives in the ER

through Computer-Aided Decision-Making

Dr. Kayvan Najarian (pictured)
Computer Science

Dr. Kevin Ward, MD
Emergency Medicine

Each year, trauma-related injuries send tens of thousands of individuals to our nation's hospitals. The emergency department (ED), commonly known as the ER, is an important entry point for the initial treatment of such patients, who are often suffering from serious, life-threatening injuries. Trauma teams work to achieve two main goals: rapidly asses the severity of each patient and provide treatment. Meeting these goals becomes even more challenging when multiple trauma patients arrive simultaneously.

Diagnosis of severity is a particularly difficult task to perform in the often fast-paced and crowded environment of an ER. Perhaps no task, however, is more important. Making an accurate diagnosis and beginning an appropriate course of treatment can mean the difference between life and death for many trauma patients. Additionally, accuracy in such preliminary diagnoses means that when a team determines that a patient has a less serious injury, he or she can be treated by a specialized or modified team, thus allowing more time, room, and valuable resources to be allocated for the treatment of those with life-threatening injuries.

Determination of trauma severity requires a review of vast amounts of patient data, including biomedical signals, images, trauma scores, demographics, and lab results on a real-time and ongoing basis. Again, going through this process in the case of just one severely injured patient is challenging, but doing it for multiple patients simultaneously is daunting. Because the failure to make the correct decisions can lead to patient deaths, the development of new tools that could quicken the diagnostic and decision-making process could be of vital help for those caring for trauma patients.

Associate professor Kayvan Najarian, Ph.D., associate director for the VCU Reanimation Engineering Science Center (VCURES), and his team in the Department of Computer Science, in close collaboration with Kevin Ward, M.D., associate professor in the Department of Emergency Medicine at VCU, have been developing computer-aided decision-making methodologies designed to provide real-time warnings of complications and recommendations of treatment to physicians while handling trauma cases. Such real-time decision-making systems are capable of integrating all available patient information and generating accurate recommendations and predictions that might allow both improvements in patient care and more optimal resource utilization. One of the main design features of these systems is the integration of a variety of complex medical information from heterogeneous sources. This includes demographic information (age, gender, etc.), injury severity scores (e.g. GCS, ISS), complications, lab test results, and other pertinent information. Moreover, the core of these systems uses computational modeling to extract key features from raw data of biomedical signals and images, such as those from the ECG, X-rays and CT scans—to compute the varying levels of critical conditions and related cause and effects. These real-time systems work at every stage of care and are designed to assist physicians in the decision-making process by combining all such available patient information. Furthermore, the systems can be specialized toward specific injuries, such as traumatic brain injury, or formulated toward multiple traumatic injuries.

Using critical care and injury databases, which include the expertise and experience of hundreds of physicians, methods have been developed to create a variety of reliable rules relating to physician care at the various levels of injury severity. Significant feature variables extracted via logistic regression of such data are then subjected to machine learning algorithms, allowing the development and analysis of decision trees. Employing such machine learning techniques creates an added level of intelligence behind the system's predictions and recommendations. The outcome of the analysis includes patient injuries, severity level, associated risks, and possible treatment recommendations. These outcomes are presented to physicians in a user-friendly interactive interface to assist and speed the decision-making process of assessing trauma patients.

Over the past couple of decades, improvements have been made in the performance and functioning of critical care in the nation's hospitals. However, the extraordinary potential of computers and dedicated intelligent systems to transform critical assessment and care has been under-explored. Although decision-support systems have been proposed in the past, no system but the computer-aided decision-making platform being developed by the VCURES team led by Najarian and Ward has analyzed all available patient information in a unified manner to generate diagnosis and treatment suggestions in real time. This platform will help to increase the physician's success rate and efficiency while at the same time improving the patient's outcome. This platform and its related systems are intended to revolutionize the way present critical care is practiced.

These projects are funded by multiple grants from the National Science Foundation, the Department of Defense, and private industry. Several of these resulting technologies have already been licensed to private companies.

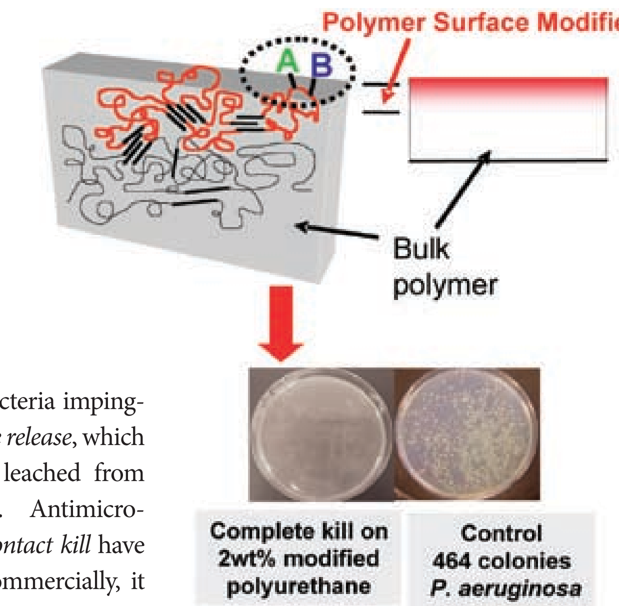
The Next Generation of Antimicrobials

Drs. Dennis Ohman and Lynn Wood, Microbiology and Immunology
Drs. Kenneth J. Wynne and Raj Rao, Chemical and Life Science Engineering (pictured)
Dr. Julio Alvarez, Department of Chemistry

Drug resistant strains of bacteria are on the rise, and the severity of the problem is now widely acknowledged both within and outside of the scientific community. "A Rising Hospital Threat," a recent article in the business section of the *New York Times* (February 27, 2010), draws attention to this issue by reporting that "infections unfazed by antibiotics become more common." One factor fueling the upswing in drug-resistant infection is a drop in the development of new antibiotics. The Infectious Disease Society of America website (www.idsociety.org/badbugsnodrugs.html) uses a chart that illustrates this problem, showing an alarming drop in the development of new antibiotics over the last twenty years—from sixteen antibiotics to only four per four-year period. Although the need for new antimicrobials is clear, the financial incentive for drug companies is complicated. Often, by the time a new drug is developed—at great cost—the use period is limited because of a buildup of resistance.

Given the need, an interdisciplinary effort involving the VCU School of Medicine, Department of Microbiology and Immunology, Chemical and Life Science Engineering, and the Department of Chemistry is taking an unconventional approach to the development of robust antimicrobial materials. Initial research focused on coatings that kill bacteria *on contact*. It is important to distinguish *contact kill* that results from bacteria impinging on a surface from *biocide release*, which occurs when biocides are leached from polymer-biocide mixtures. Antimicrobial coatings that provide *contact kill* have seen little development. Commercially, it is faster to just add an antibiotic or antimicrobial (for example, silver) to a polymeric material. However, once the antimicrobial has leached out, the coating is no longer effective. In contrast, the goal of the research is a long-lasting contact kill that could be useful in applications such as urinary catheters, which are the cause of over 60 percent of hospital-acquired infections.

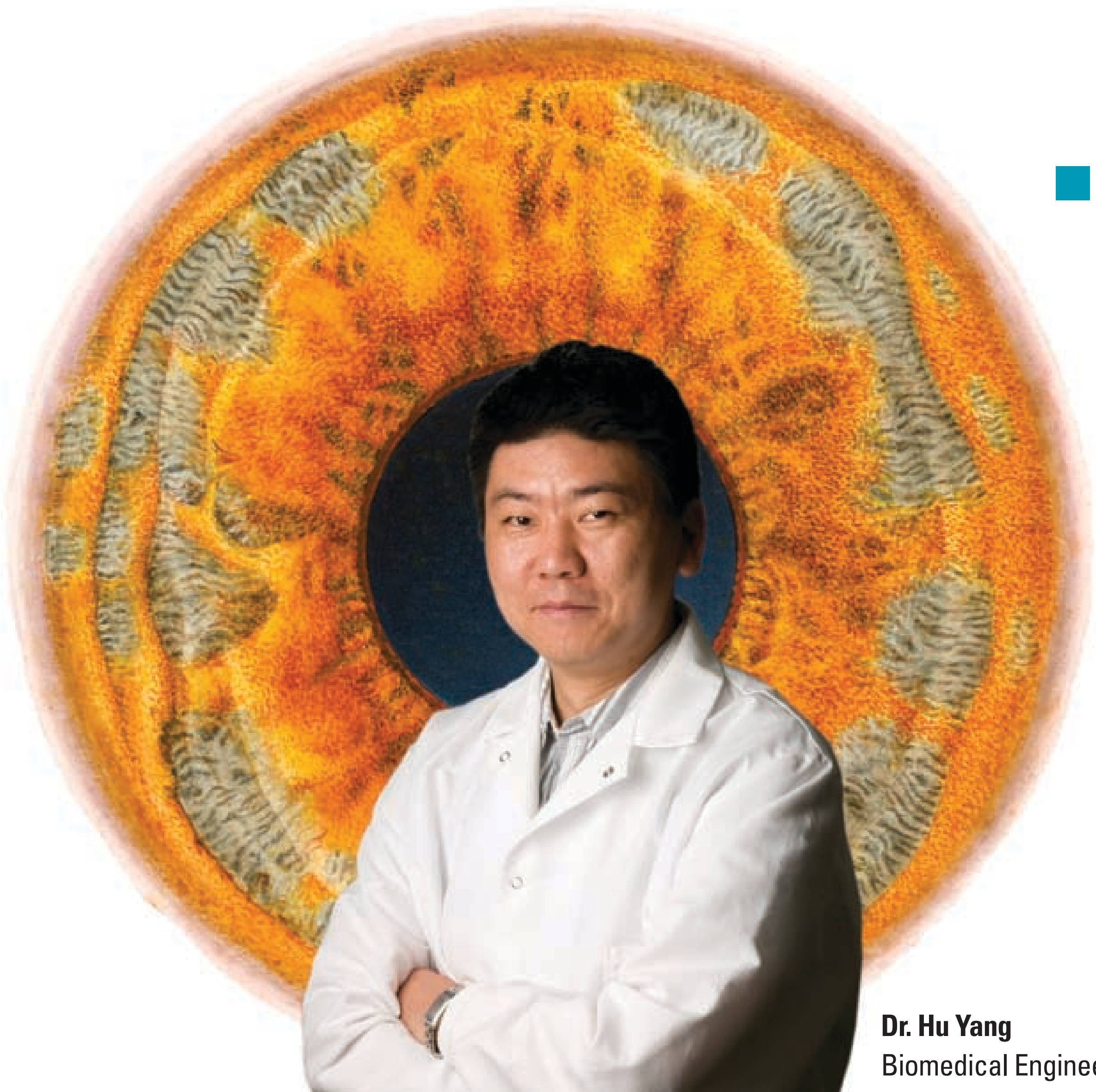
The VCU team leaders are professors Dennis Ohman and Dr. Lynn Wood, Microbiology and Immunology; professors Raj Rao and Kenneth J. Wynne, Chemical and Life Science Engineering; and professor Julio Alvarez, Department of Chemistry. Three scientific papers already resulted from initial collaborative research, including a key initial paper involving the Ohman and Wynne groups. Current research is focused on increasing the "shelf-life" of contact antimicrobial coatings. Because the materials research involves "pinning" detergent-like charge at coating surfaces, important insights into the factors controlling stability have come from the collaboration between the Wynne and Alvarez groups. These research results have revealed an important screening method that could avoid time-intensive bio-screening.



Surface concentration of quaternary charge via polymer surface modifiers

Complementing the coating developments, a serendipitous finding related to the coatings research has resulted in a new class of powerful, *water soluble* antimicrobials. Through a collaboration of the Wynne and Rao groups, the new antimicrobials have been shown to have minimal toxicity to human cells. Thus, if antibiotics result from these findings, side effects may be minimized. There is a long road between discovery and ultimate application, however. For example, research needs to establish whether bacteria develop resistance to the new antimicrobials. The proposed mechanism of action is based on interactions with the bacterial cell wall. It is hoped that bacteria cannot build resistance.

The authors thank the National Science Foundation DMR (grants DMR-0207560 and DMR-0802452) for support of this research. Professor Alvarez thanks NSF, Chemistry Division (grant CHE-0645494) for support of this research.



Dr. Hu Yang
Biomedical Engineering

Iris illustration courtesy of Alex Meredith

Preserving Sight,

a Novel Drug-Delivery Platform to Treat Glaucoma

Glaucoma is a group of diseases that can damage the eye's optic nerve and result in vision loss and blindness. According to the World Health Organization, glaucoma, including open-angle glaucoma and angle-closure glaucoma, is the second leading cause of blindness in the world. In the United States, 2.2 million Americans age forty and older are affected by open-angle glaucoma. In addition, another 2 million do not know they have the disease. Intraocular pressure (IOP) is the most important risk factor. As of today, it still remains the only risk factor that can be treated to prevent the disease's progression.

Various classes of antiglaucoma agents have been developed to lower IOP (preferably below 12 mm Hg), including beta blockers (e.g., timolol), prostaglandin analogues (e.g., latanoprost), alpha-adrenergic agonists (e.g., brimonidine), and carbonic anhydrase inhibitors (e.g., dorzolamide).

The safe and effective treatment of glaucoma, like that of most ophthalmic diseases or disorders, relies heavily on topical application of drugs to the eye. Because of ease of use and low-cost production, conventional dosage forms (including aqueous solutions, suspensions, and ointments) dominate the global market of ocular drug delivery, accounting for nearly 90 percent of marketed formulations.

Most marketed antiglaucoma drugs are formulated into solutions and suspensions. However, such conventional delivery systems have drawbacks, such as increased precorneal elimination, high variability in efficiency, and blurred vision. Further, the barriers of the precorneal tear clearance and the highly selective corneal epithelium results in low bioavailability (less than 5 percent or even below 1 percent) and short duration of activity for those antiglaucoma agents. As a consequence, maintenance of lowered IOP demands frequent dosing (e.g., twice daily for timolol (Timoptic®) and three times daily for brimonidine (Alphagan® P)), which, in turn, causes poor patient compliance.

Because topical application is the most convenient route for long-term glaucoma treatment, considerable efforts have been placed on exploring new topical delivery carriers and formulations. These efforts have focused on increasing the ocular-residence time of drugs and drug adsorption, which are essential for increasing the duration of drug activity. Nonconventional delivery systems and formulations for topical application of antiglaucoma drugs are also under rapid development, and this has been a research focus for interdisciplinary collaborators between the School of Engineering, and the School of Medicine. Recently, Dr. Hu Yang, assistant professor, Department of Biomedical Engineering and his clinical collaborators including Dr. Christopher Leffler, assistant professor of ophthalmology at VCU, and Dr. Uday Kompella, professor of pharmaceutical sciences at University of Colorado Denver, have developed a novel, highly adaptable and multifunctional polyamidoamine (PAMAM) dendrimer hydrogel platform with potential for ocular drug delivery.

As illustrated in Figure 1, a dendrimer hydrogel network consists of PAMAM dendrimer nanoparticles crossed linked with polyethylene glycol (PEG). The novelty of dendrimer hydrogel (DH) is that it possesses many unique structural characteristics and desirable properties for ocular drug delivery as follows: First, PAMAM dendrimers are highly branched nanoparticles with a number of surface groups and charges. The dendrimer hydrogel network allows for simultaneous delivery of both hydrophobic and hydrophilic drugs as needed. In particular, the interior hydrophobic core of the dendrimer can encapsulate hydrophobic compounds, thus increasing their water solubility and loading amounts, while the cross-linked PEG network can load hydrophilic drugs. Second, DH solutions are light sensitive and are able to become viscous solutions or form gel in situ upon light exposure. Third, DH exhibits pH-dependent degradation responsiveness, controllable release kinetics, and swelling behavior. Fourth, DH has demonstrated good mucoadhesiveness, making possible sustained drug release, and it has favorable biological properties, such as non-toxicity. Further, this new platform integrates the structural characteristics and properties of in situ gelling, mucoadhesive, and nanoparticle delivery systems, representing a new generation of ocular drug delivery platform.

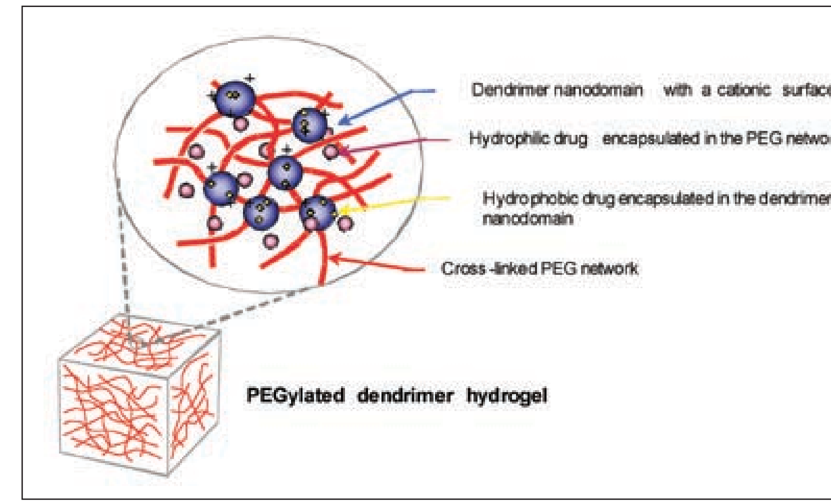


Figure 1. A highly adaptable and multifunctional PAMAM dendrimer hydrogel platform for ocular drug delivery

Developing long-acting antiglaucoma drug dosage formulations represents an unmet clinical need of improving long-term patient compliance. With support from the Wallace H. Coulter Foundation through a translational research award granted to Yang, Leffler, and Kompella, the current focus is to prove the feasibility of developing a new dosage formulation based on this novel dendrimer hydrogel platform to enhance the bioavailability and/or prolong the therapeutic efficacy of antiglaucoma drugs in the hope of reducing the dosing frequency to improve long-term patient compliance.

Each member of the research group makes a significant contribution to the project. Leffler is currently working on the association of beta-adrenergic receptor polymorphisms with response to glaucoma medications and has determined optimal methods to evaluate glaucoma drug effect in clinical practice. The variation observed in intraocular pressure control has played a part in convincing him of the need for long-acting glaucoma therapeutics. Prototype products will be validated in animal studies in collaboration with Kompella. Dr. Stephen Hutcherson, president and CEO at Visionary Therapeutics Corporation, serves as consultant to this project, providing advice on product commercialization. Yang works closely with the VCU technology transfer office for patent application, licensing and commercialization of this technology. Before receiving the Coulter award, Yang was awarded the VCU Technology Validation Fund in 2008 for pilot study of this technology.

The versatility of this novel ocular drug delivery platform ensures that products are capable of rapid evolution and transition as new formulations are discovered. The validation of DH for antiglaucoma drug delivery will open up opportunities for developing DH formulations for delivery of other ocular drugs because of DH's high structural adaptability and its favorable properties.

Understanding Integrase Inhibitors in the Fight Against HIV

Dr. Vamsi Yadavalli, Chemical and Life Sciences Engineering
Dr. Allison Johnson, Center for the Study of Biological Complexity

Human immunodeficiency virus (HIV), which infects and ultimately destroys or impairs the cells of the human immune system, is one of the most far-reaching public health crises in the world. Current estimates indicate at least 60 million people worldwide have been infected with HIV, and 25 million people have died of HIV-related causes (UNAIDS data for 2009). The number of deaths attributable to AIDS peaked in 2004, but has shown a pronounced decline to less than 2 million in 2008, because of the use of anti-retroviral therapy including a cocktail of drugs. These drugs target HIV proteins to inhibit multiple steps of the pathway of HIV infection, including virus entry into cells, viral replication, processing, and most recently, integration.

Some strains of HIV, however, resist available therapies, and the scientific community is challenged with the task of combating these emerging strains by developing new HIV inhibitors and understanding these inhibitors' mechanism of action. VCU researchers Dr. Vamsi Yadavalli, Department of Chemical and Life Sciences Engineering, and Dr. Allison Johnson Center for the Study of Biological Complexity, have responded to this challenge by focusing their collaboration on learning more about how the HIV protein integrase works and how inhibitors block integrase function.

Yadavalli and Johnson study HIV-1 integrase, a viral protein responsible for insertion of the viral DNA genome into human chromosomes, resulting in completion of viral infection. Once integration occurs, that cell remains infected with viral DNA until it is destroyed or dies. Integration requires integrase to bind both ends of the linear viral DNA as well as the host chromosomal DNA. The interactions between integrase and the viral and host DNAs are complex. The three-dimensional structure of full-length HIV integrase (in the presence or absence of DNA) has proven difficult to resolve, limiting understanding of the interactions between integrase and the viral DNA. Additionally, previous "bulk" studies used to measure integrase/DNA binding are complicated by pre-binding changes in the arrangement and oligomeric state of the protein. Thus, the mechanism of DNA recognition by integrase and the role of DNA sequence-specificity during binding are poorly understood. Determination of the molecular interactions between integrase and DNA is required for mechanistic understanding of this viral protein as well as future anti-HIV drug development.

Yadavalli and Johnson use atomic force microscopy (AFM, see image) to examine the single molecule interactions of HIV-1 integrase with DNA substrates. Accurate determination of interaction forces would provide critical functional information about integrase in complex with DNA. AFM is the method of choice because it allows for the characterization of interaction forces between individual biological molecules and their substrates. This approach is unique because AFM offers the opportunity to define integrase/DNA interactions by measuring the force required to pull apart an enzyme-substrate complex, rather than monitoring formation of the complex. The AFM will allow Yadavalli and Johnson to bring a single molecule of integrase together with a single DNA substrate. They can then characterize that interaction and observe the force required to pull them apart. In this way, the effects of enzyme changes occurring during DNA binding will be negated, and they can focus on the examination of the interactions occurring in the integrase/DNA complex.

Measuring the interaction forces of the integrase/DNA complex is also important for understanding how integrase inhibitors work. The first integrase inhibitor to treat AIDS was approved by the FDA in October 2007 after fifteen years of research. Measuring the effect of inhibitors on the formation of integrase/DNA complexes by atomic force microscopy will further the understanding of the mechanism of these inhibitors and this clinically important viral target.

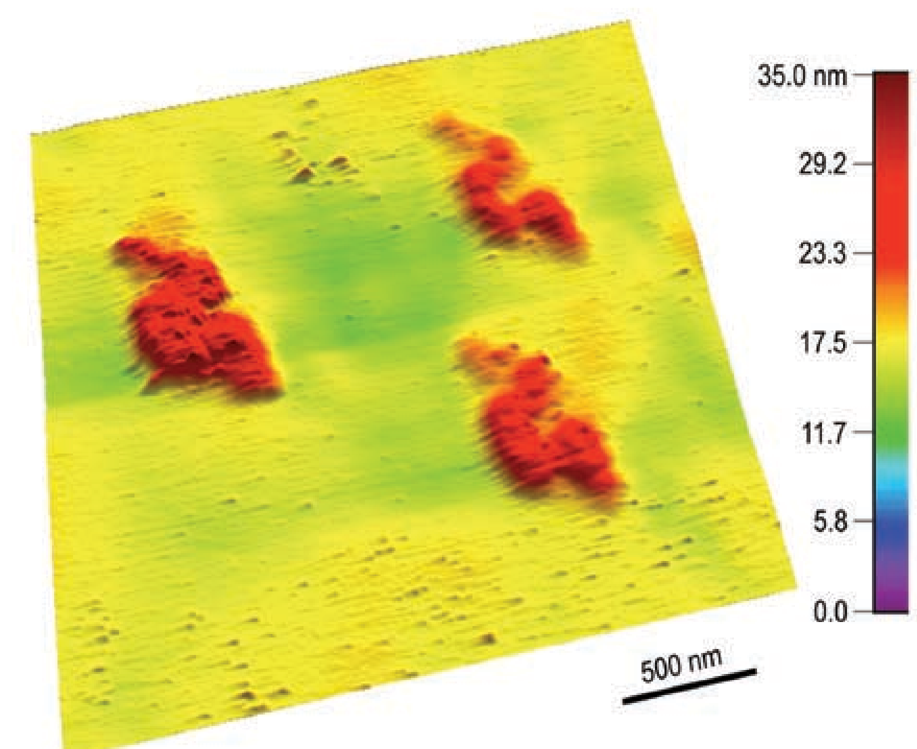


Figure legend: Atomic force microscopy image of HIV-1 integrase on a mica surface. The AFM cantilever "taps" across a surface in "scanning mode" to map the topology of molecules on the surface. The color map on the right indicates the height of the molecule and the scale bar indicates the width.

Screenings of the Future:
Accurate, Early Cancer Detection

According to the American Cancer Society, colorectal cancer is the second leading cause of cancer-related deaths in the United States. According to statistics for 2009, colorectal cancer was expected to cause about 50,000 deaths. Fortunately, the death rate (the number of deaths per 100,000 people per year) from colorectal cancer has been dropping for more than twenty years. There are a number of likely reasons for this decrease, such as improvements in the treatment for colorectal cancer and improvements in screening. Polyps—a precursor of colorectal cancers—can be found by screening and removed before they can develop into cancers. Screening also allows for the earlier detection of colorectal cancers, when the disease is easier to cure.

Computed tomographic (CT) colonography, or virtual colonoscopy, is a promising technique for screening colorectal cancers by means of CT scans of the colon. The prevailing CT technology allows a single image set of the colon to be acquired and translated into an easier, more comfortable examination than is available with other screening tests. For CT colonography to be a clinically practical method of screening for colon cancers, the technique must be able to interpret a large number of images in a time-effective fashion, and it must facilitate the detection of polyps with high accuracy. However, interpretation of an entire CT colonography examination can be time-consuming, and the reader performance for polyp detection can vary substantially.

To overcome these difficulties while providing an accurate detection of polyps, Computer-Aided Detection (CAD) schemes, which automatically detect suspicious lesions in CT colonography images, have been developed. CAD for CT colonography provides the locations of the suspicious polyps to radiologists, offering a second opinion that has the potential to improve detection performance through screening. Polyps appear as bulbous, cap-like structures that adhere to the colonic wall and protrude into the lumen, whereas folds appear as elongated, ridge-like structures, and the colonic wall appears as a large, nearly flat structure. In this research, pattern recognition and machine-learning techniques are being incorporated to achieve a fast, flexible, and accurate method for the detection of polyps in CT colonographic images by effectively incorporating semi-supervised on-line learning methods and an appearance-based object recognition approach into a model-based CAD scheme.

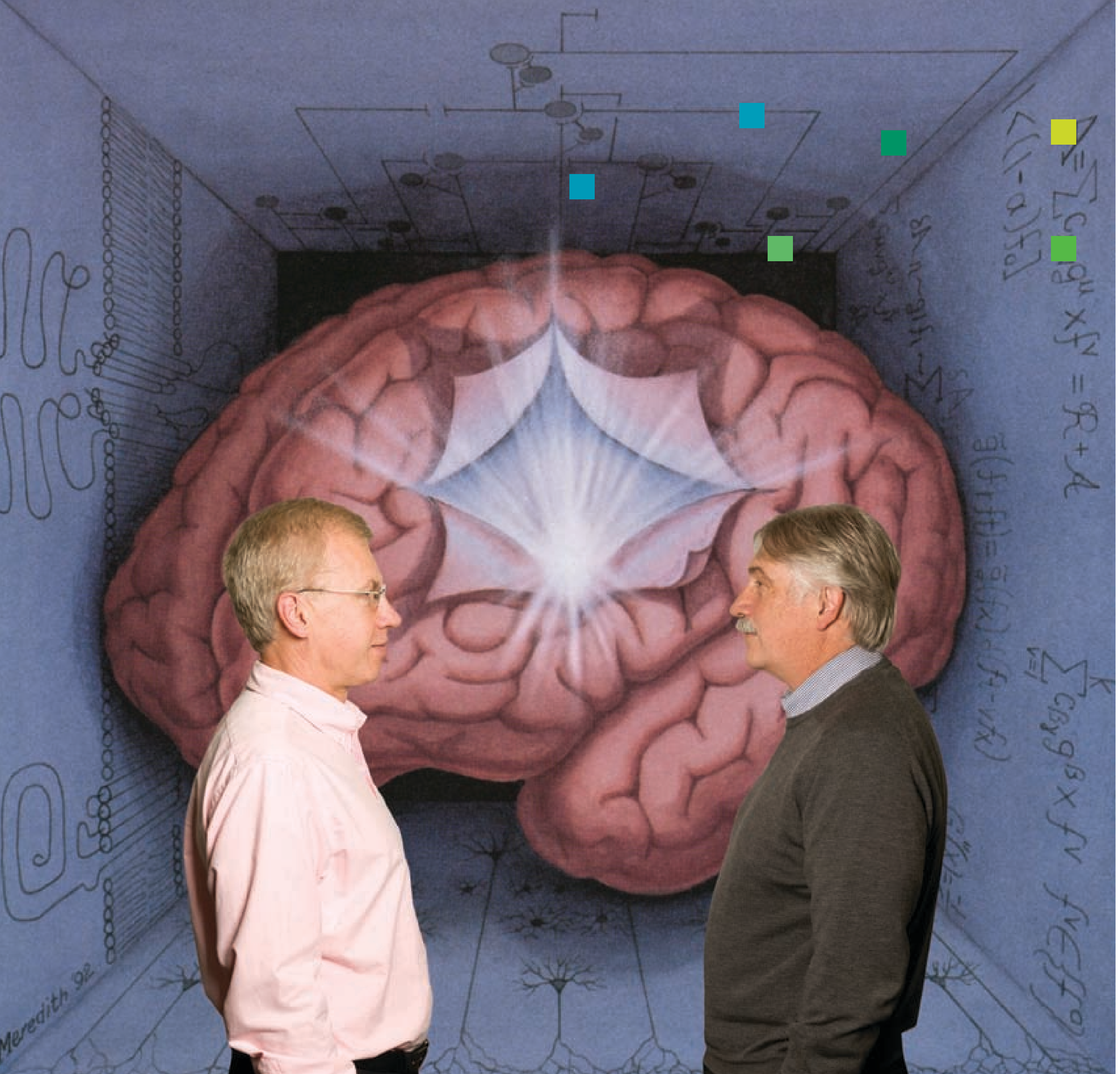
Traditionally, CAD schemes have been developed for offline applications, where resources and training requirements are proportional to the number of training instances. Thus, if more training data are collected after the initial tumor model is computed, retraining of the model becomes imperative in order to incorporate the incremental data and preserve the class concept. Contrary to such traditional learning techniques, on-line learning refers to incorporating new data that become available in the already computed model.

On-line learning, whether non-incremental or incremental, is very important, particularly when obtaining training data is time-consuming, when the statistical properties of data change dynamically, or when there is a need for efficient use of limited storage space. One important advantage to on-line training is that each pattern is presented once and only once. Thus, additional memory for storing the patterns is not necessary, as only the most pertinent information identified by the learning technique is retained. Therefore, this new method allows for efficient use of storage space. As the learning progresses, the dynamic changes of the newly fed data can be captured and learned. Therefore, this can be identified as a semi-supervised learning method for computer-aided detection of polyps in CT colonography. Although performance depends on the characteristics of a particular dataset, the experimental results so far demonstrate faster detection (about 4.4 times faster than traditional offline method) with a very small loss in reconstruction accuracy (less than one percent). The use of sufficient training data for the initial off-line step, together with the optimum number of features to be extracted (depending on the characteristics of the dataset for a given application), are expected to enhance the reconstruction accuracy. While the flexibility of the method lies in its ability to perform faster learning and detection, it is also very well-suited for extracting features from data with time-varying statistical properties.

The researchers would like to acknowledge Drs. J. Näppi and H. Yoshida of Radiology, Massachusetts General Hospital and Harvard Medical School, for providing CT datasets for this research. The associated faculty members at VCU include Drs. Alen Docef and Yuichi Motai of Electrical and Computer Engineering. Dr. Jeffrey Williamson of Radiation Oncology serves as a mentor for Dr. Motai. The Massey Cancer Center at MCV supports these efforts, which have produced five journal manuscripts and have awarded two Master's degrees of Science (Ms. Winter and Ms. Myla) in 2010.

Dr. Yuichi Motai and Dr. Alen Docef,
Electrical and Computer Engineering
(pictured)

Dr. Jeffrey Williamson, Radiation Oncology,
The Massey Cancer Center at MCV



Nonparametricapproaches to Neuroscience illustration courtesy: Alex Meredith

Closing the Gap
Between Computers and the Brain

Dr. Krzysztof (Krys) Cios, Computer Science, (pictured left)
Dr. Alex Meredith, Anatomy and Neurobiology, (pictured right)

Inquiries into the relationship between the brain and the computer began in the 1950s, through the pioneering work of researchers such as Alan Turing and Otto Schmitt. From this work emerged questions about the brain's functions and how those functions could be modeled, imitated, and built upon by computers.

Dr. Krzysztof (Krys) Cios, professor and chair of the Computer Science Department, and his collaborators, Drs. Alex Meredith and Les Keniston, of the Anatomy and Neurobiology Department, plus Cios's doctoral students Hun Ki Lim and Joo Heon Shin, have been using an approach known as biomimetics to understand how brain functions can be used as a model for making computer learning algorithms run more efficiently.

Specifically, their current work investigates the way the brain perceives and processes sensory stimuli. Of particular interest is multisensory processing, which is carried out by neurons that respond to stimuli from more than one sensory modality, such as both vision and hearing. The team is modeling the way information from these different sensory systems converge onto individual neurons. The ultimate goal of their research is to both gain insight into the function of the brain and to design high-performance computer learning algorithms.

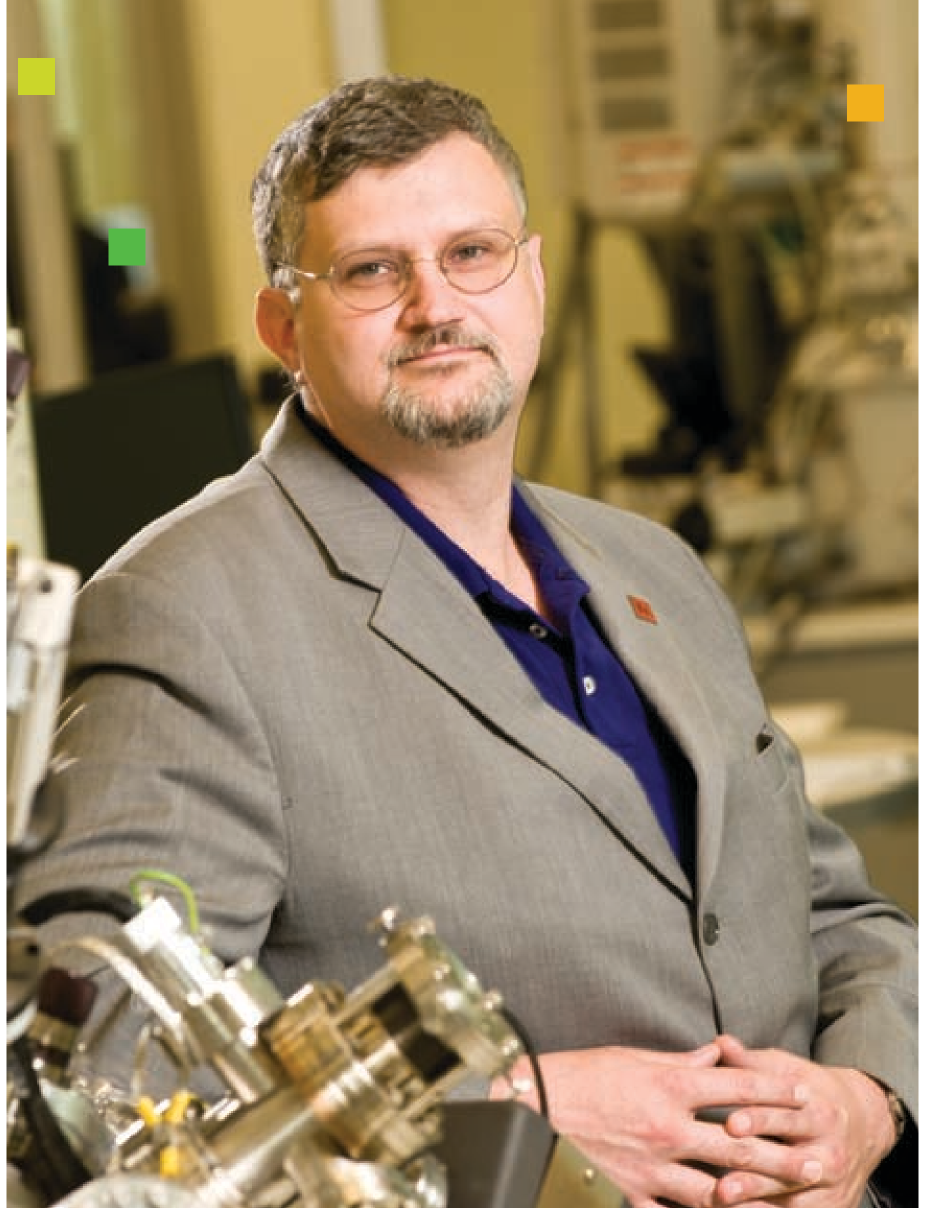
In general, simulation of brain function involves a process that includes conceptual definition and design, mathematical and computational modeling, testing the correlation between model output and the brain, and generation of biologically testable hypotheses. Processing simulators provide a specific simulation environment in which computational models can be custom built according to their conceptual model of interest as well as evaluate the result of the simulation by using analytic tools in the simulator. However, the complexity of the brain makes it unlikely that the available simulation tool packages can adequately address all neural properties. Therefore, new simulators need to be developed to address specific facets of brain organization and function.

A particularly useful feature of such synthetic networks is their ability to simulate biological features that are experimentally inaccessible, such as the manipulation and control of neural connectivity that underlies neuronal activity. This is especially relevant to the examination of the multisensory nature of the brain, where connections from one sensory modality impinge on those from another to influence neural activity that underlies important functions from behavior to perception. Important research questions hinge around whether simple convergence of inputs from different sources can generate features of multisensory processing, and if not, what kind of special constants/factors or training are required?

To address this convergence problem, the team headed by Cios and Meredith has developed the Neuronal Multisensory Processing Simulator (NMPS) as a computational environment for designing networks of spiking neurons to evaluate the properties that underlie multisensory processing. The NMPS performs simulations of multisensory convergence by generating network models and evaluates the functional result of that convergence with tools that measure the spiking activity of the constituent neurons. In a recent study, although a wide variety of topologies could be generated, convergence was simulated by the projection of neurons from two distinct areas onto shared neurons in a third area. Simulated current injection in one or both of the separate areas activated the network. Analysis of both neurons and network revealed responses similar to biological multisensory processing. Thus, the NMPS provided insight into aspects of a biological system otherwise inaccessible to experimental observation and manipulation. Ultimately, the flexible and comprehensive design of the NMPS will permit similar examinations of a variety of neurobiological problems.

According to Cios, "By mimicking the way in which the brain processes information, we have worked to enhance the performance of computers on brain-like tasks. Toward this end, we have used our results to design a system that was able to recognize human facial images over a wide range of views, including that of partially occluded and rotated, and to do so much more accurately than the existing state-of-the-art image classification systems."

The simulator can be accessed at www.egr.vcu.edu/cs/dmb/projects/nmps/.



Students Learn to Study Small in New Nanoscience and Nanotechnology Program

Dr. Everett Carpenter, Chemistry

Research collaborations among faculty in the School of Engineering, the School of Medicine, and the College of Humanities and Sciences are characterized by a dynamic, interdisciplinary spirit, and through the introduction of a new doctoral degree program in nanoscience and nanotechnology and the creation of the Nanomaterials Core Characterization Facility, VCU strives to instill that spirit in the next generation of scientists and engineers.

The new Nanoscience and Nanotechnology Program was developed by faculty in the VCU Departments of Chemistry and Physics and accepted its first students in January 2010. The program is designed to cross-train students in the physical sciences with particular focus on how the science changes at reduced dimensions. Students in this program will explore the rapidly emerging dynamic fields of nanoscience and nanotechnology. Specifically, they will be working at the nanoscale to create and manipulate new materials with the goal of developing new technologies that could ultimately benefit society.

Everett Carpenter, Ph.D., interim director of the Nanoscience and Nanotechnology Program and director of the Nanomaterials Core Characterization Facility, indicates that students will get a broader education on the issues affecting the research, rather than getting a Ph.D. in chemistry or physics with their research being in nano. The new curriculum prepares students for future positions in industry or government research by providing an opportunity to work beyond traditional scientific boundaries through examining the theoretical underpinnings of nano and learning how they are part of a bigger picture.

The interdisciplinary doctoral degree program in nanoscience and nanotechnology is the first of its kind in the state, and one of only a handful of programs in the United States.

The new program is supported by the Nanomaterials Core Characterization Facility, a 4,000-square-foot, state-of-the-art facility located within the new Health and Life Science Engineering Facility.

The facility is outfitted with the necessary equipment to expand VCU's capabilities for research in materials science, a field in which chemists, engineers, or physicists can change, manipulate, or tailor the surface, size, or shape of a particular material to create new ones or improve upon older ones.

In the past year, VCU received two major National Science Foundation research instrumentation grants totaling more than $1.1 million. Combining these federal awards with state instrumentation grants and private donations, the Nanomaterials Core Characterization Facility has been able to build a state-of-the art facility with more than $4 million in new equipment. This new equipment will allow faculty and student researchers from VCU's campuses, as well as other universities and industries along the East Coast, to use cutting-edge instrumentation for materials characterization.

To learn more about the facility and the new Ph.D. program in Nanoscience and Nanotechnology, please visit www.nano.vcu.edu.

VCU School of Engineering FACULTY
2010-2011 Academic Year

BIOMEDICAL

Dr. Ou Bai
Assistant Professor
E-mail: obai@vcu.edu
Phone: (804) 828-7956
Fax: (804) 828-4454
Research Topics
- Algorithms and systems development of brain-computer interface
- Human motor control physiology
- Development of brain-computer interface-based device for patients with movement disorders
- System development of imagery-based motor learning for stroke rehabilitation
- Development of algorithms and graphic-user interface for investigation brain neuronal connectivity
- Development of algorithms and systems for computer-aided diagnosis
- Algorithm development of neurophysiological signal processing and classification
- Multi-modal functional neural imaging

Dr. Gary L. Bowlin
Professor
Harris Exceptional Scholar Professorship
Assistant Chair/Graduate Coordinator
Director, Tissue Engineering Laboratory
E-mail: glbowlin@vcu.edu
Phone: (804) 828-2592
Fax: (804) 828-4454
Website: http://www.people.vcu.edu/%7Eglbowlin
Research Topics
- Electrostatic endothelial cell seeding techniques and transplantation/transfection
- Development of novel tissue engineering scaffolds via electrospinning

Dr. Ding-Yu Fei
Associate Professor
E-mail: dfei@vcu.edu
Phone: (804) 828-2664
Fax: (804) 828-4454
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=15
Research Topics
- Bioinstrumentation
- Telemedicine
- Magnetic resonance imaging (MRI) techniques for studies of vessel properties and vascular hemodynamics
- Ultrasonic imaging techniques for studies of cardiovascular dynamics

Dr. Tom Haas
Professor
E-mail: thaas@vcu.edu
Phone: (804) 827-0446
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=23
Research Topics
- Biomaterials

Dr. Russell D. Jamison
Dean and Professor
E-mail: rjamison@vcu.edu
Phone: (804) 828-0190
Fax: (804) 828-9866
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=32
Research Topics
- Tissue engineering of bone

Dr. Martin L. Lenhardt
Professor
E-mail: mllenhar@vcu.edu
Phone: (804) 828-9687
Fax: (804) 828-4454
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=39
Research Topics
- Non-invasive cerebral spinal fluid pressure device
- High noise speech communication system
- Baby echolocator (device to allow deaf babies to "see" acoustically facilitating perceptual motor development)
- Baby multimodal (bone conduction and vibrotactile) hearing aid using algorithms to track mother's voice
- Tinnitus (phanton sound sensation) management system using very high frequency stimulation with custom actuator

Dr. Gerald E. Miller
Professor and Chair
E-mail: gemiller@vcu.edu
Phone: (804) 828-7263
Fax: (804) 827-0290
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=49
Research Topics
- Rehabilitation engineering - analysis and design of devices to aid the disabled
- Man-machine interfacing - analysis and design of voice-recognition systems
- Artificial hearts - analysis and design of a multiple disk centrifugal blood pump

Dr. Dianne T.V. Pawluk
Assistant Professor
E-mail: dtpawluk@vcu.edu
Phone: (804) 828-9491
Fax: (804) 828-4454
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=56
Research Topics
- Haptic displays for blind and visually impaired individuals
- Haptic devices for rehabilitation
- Haptic technology for engineering education
- Human factors analysis during minimally invasive surgery
- Tissue modeling for surgical simulators

Dr. Jennifer S. Wayne
Professor
E-mail: jswayne@vcu.edu
Phone: (804) 828-2595
Fax: (804) 828-4454
Website: http://www.people.vcu.edu/%7Ejwayne/jwayne.htm
Research Topics
- Structural stability of fixation constructs
- Ligament and tendon mechanics
- Experimental and computational modeling of diarthrodial joint function
- Articular cartilage: normal function, reparative techniques, tissue engineering

Dr. Paul A. Wetzel
Associate Professor
E-mail: pawetzel@vcu.edu
Phone: (804) 827-0487
Fax: (804) 828-4454
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=78
Research Topics
- Eye tracking systems and eye movement analysis
- Effects of neurological diseases on eye movement control
- Visual task analysis
- Physiological instrumentation and signal processing systems
- Human-machine interfaces based on eye and head movement

Dr. Hu Yang
Assistant Professor
E-mail: hyang2@vcu.edu
Phone: (804) 828-5459
Fax: (804) 827-0290
Website: http://www.people.vcu.edu/~hyang2
Research Topics
- Bioactive and environment-responsive surfaces for pharmaceutical and biomedical applications
- Brain-targeted drug delivery and gene therapy
- Dendrimer-based drug delivery, controlled release, and gene transfer
- Nanomedicine
- Tissue regeneration
- Polymer synthesis, characterization, and biofunctionalization

CHEMICAL AND LIFE SCIENCE

Dr. Stephen S. Fong
Assistant Professor
E-mail: ssfong@vcu.edu
Phone: (804) 827-7038
Fax: (804) 828-3846
Website: http://www.engineering.vcu.edu/fong-lab
Research Topics
- Systems biology
- Synthetic biology
- Evolutionary biology
- Metabolic engineering
- Computational modeling

Dr. B. Frank Gupton
Professor and Interim Chair
E-mail: bfgupton@vcu.edu
Phone: (804) 828-4799
Fax: (804) 828-3846
Website: http://www.egr.vcu.edu/clse/faculty-staff/gupton.html

Dr. Russell D. Jamison
Dean and Professor
E-mail: rjamison@vcu.edu
Phone: (804) 828-0190
Fax: (804) 828-9866
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=32
Research Topics
- Tissue engineering of bone

Dr. Henry A. McGee Jr.
Founding Dean, Dean Emeritus and Professor,
E-mail: hmcgee@vcu.edu
Phone: (804) 828-3636
Fax: (804) 828-3846
Website: http://www.egr.vcu.edu/clse/faculty-staff/mcgee.html

Dr. Mark A. McHugh
Professor
E-mail: mmchugh@vcu.edu
Phone: (804) 827-7031
Fax: (804) 828-3846
Website: http://www.egr.vcu.edu/clse/faculty-staff/mchugh.html
Research Topics
- Polymer solution behavior at high pressures
- Scattering phenomena in polymer solutions at high pressures
- Supercritical fluid solvent technology

Dr. Michael H. Peters
Professor
E-mail: mpeters@vcu.edu
Phone: (804) 828-7789
Fax: (804) 828-3846
Website: http://www.egr.vcu.edu/clse/faculty-staff/peters.html
Research Topics
- Small molecule drug synthesis
- Cellular therapeutics
- Real-time biomolecular simulation
- Vascular tissue engineering
- Stem cell engineering

Dr. Raj R. Rao
Qimonda Assistant Professor
E-mail: rrrao@vcu.edu
Phone: (804) 828-4268
Fax: (804) 828-3846
Website: http://www.engineering.vcu.edu/rao-lab
Research Topics
- Stem cells
- Regenerative medicine
- Cellular/tissue engineering
- Genomics
- Biomaterials
- Cell-based assays

Dr. Kenneth J. Wynne
Professor
E-mail: kjwynne@vcu.edu
Phone: (804) 828-9303
Fax: (804) 828-3846
Website: www.engineering.vcu.edu/wynne-lab
Research Topics
- Polymer surface science
- Fluoropolymer science
- Silicone science
- Functional polymer surfaces including biocidal polymers
- Nonlithographic patterning of functional inorganic, and polymeric materials

Dr. Vamsi Yadavalli
Assistant Professor
E-mail: vyadavalli@vcu.edu
Phone: (804) 828-0587
Fax: (804) 827-3846
Website: http://www.egr.vcu.edu/clse/faculty-staff/yadavalli.html
Research Topics
- Single molecule biophysics
- Protein-protein and protein-surface interactions
- Optical biosensors
- Functional biomaterials
- Micro- and nano-fabricated devices
- Biophotonics

COMPUTER SCIENCE

Dr. James E. Ames IV
Associate Professor
E-mail: james@vcu.edu
Phone: (804) 827-4007
Fax: (804) 828-2771
Website: http://www.people.vcu.edu/%7Ejames/
Research Topics
- Computer security, medical applications, semi-real-time algorithms, performance evaluation, graphics, database and networks

Dr. Tomasz Arodz
Assistant Professor
Phone: (804) 827-3989
Fax: (804) 828-2771
Research Topics
- Computational analysis of complex metabolic networks to study robustness for evolutionary related/distant species
- Computational and statistical exploration of rules that govern evolution of proteins
- Development of pattern recognition and machine learning methods for applications in biomedical informatics

Dr. Chao-Kun Cheng
Professor Emeritus
E-mail: ccheng@vcu.edu
Phone: (804) 827-4008
Fax: (804) 828-2771
Website: www.egr.vcu.edu/FacultyDetail.aspx?facid=9
Research Topics
- Cellular automata, compilers, functional programming, logic programming and expert systems

Dr. Krzyzstof Cios
Professor and Chair
E-mail: kcios@vcu.edu
Phone: (804) 828-9671
Fax: (804) 828-2771
Website: http://www.egr.vcu.edu/cs/dmb/
Research Topics
- Neuroinformatics, bioinformatics, data mining and learning algorithms

Dr. Vojislav Kecman
Associate Professor
Email: vkecman@vcu.edu
Phone: (804) 827-3608
Fax: (804) 828-2771
Website: http://www.people.vcu.edu/~vkecman
Research Topics:
- Machine learning, data mining
- Bioinformatics, biomedical informatics
- Fuzzy logic modeling
- System dynamics modeling and analysis
- Algorithms for parallel, GPU based and cloud computing

Dr. Yuan Gao
Assistant Professor
E-mail: ygao@vcu.edu
Phone: (804) 440-6725
Fax: (804) 828-2771
Website: http://www.engineering.vcu.edu/fac/gao/
Research Topics
- Computational biology
- Genome sequencing
- Algorithm design and analysis
- Data mining
- Computer and biological networks

Dr. Branson Murrill
Associate Professor
E-mail: bmurrill@vcu.edu
Phone: (804) 827-3999
Fax: (804) 828-2771
Website: http://www.people.vcu.edu/%7Ebmurrill/
Research Topics
- Software analysis, testing, verification, and reliability

Dr. Kayvan Najarian
Associate Professor
E-mail: knajarian@vcu.edu
Phone: (804) 828-9731
Fax: (804) 828-2771
Website: http://www.people.vcu.edu/~knajarian/
Research Topics
- Biomedical signal and image processing
- Biomedical informatics
- Signal processing for finance and banking

Dr. Lorraine M. Parker
Associate Professor
E-mail: lparker@vcu.edu
Phone: (804) 827-4006
Fax: (804) 828-2771
Website: http://www.people.vcu.edu/%7Elparker/
Research Topics
- Database systems, operating systems and concurrency

Dr. David Primeaux
Associate Professor
E-mail: dprimeau@vcu.edu
Phone: (804) 827-4003
Fax: (804) 828-2771
Website: http://www.people.vcu.edu/%7Edprimeau/
Research Topics
- Artificial neural networks
- Machine learning
- Knowledge-based systems
- Parallel algorithms
- Ethics

Dr. Dan Resler
Associate Professor
E-mail: dresler@vcu.edu
Phone: (804) 828-3987
Fax: (804) 828-2771
Website: http://cmsc1.egr.vcu.edu/~resler/
Research Topics
- Programming languages
- Compiler design
- Automatic generation of software

Dr. Meng Yu
Associate Professor
E-mail: myu@vcu.edu
Phone: (804) 827-3986
Fax: (804) 828-2771
Research Topics
- System security: cloud computing security, distributed system security, and data processing systems security
- Mechanisms to enable new detection, defense, and response techniques
- Mobile device and wireless network security
- Defense mechanisms in multi-interface multi-channel wireless networks

Dr. Wanyu Zang
Assistant Professor
E-mail: wzang@vcu.edu
Phone: (804) 827-4002
Fax: (804) 828-2771
Research Topics
- Wireless network security and DDOS attacks
- Intrusions and defense mechanisms in multi-interface multi-channel wireless networks
- System recovery including self-healing systems and survivability analysis

ELECTRICAL / COMPUTER

Dr. Gary M. Atkinson
Associate Professor
Director of the Wright-Virginia Microelectronics Center
E-mail: gmatkins@vcu.edu
Phone: (804) 827-0185
Fax: (804) 827-0006
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=3
Research Topics
- Microelectromechanical Systems (MEMS)
- Biochips
- Sensors and actuators
- Smart materials
- Micro/nano fabrication

Dr. Supriyo Bandyopadhyay
Professor
E-mail: sbandy@vcu.edu
Phone: (804) 827-6275
Fax: (804) 827-0006
Website: http://www.people.vcu.edu/~sbandy/qdl1.html
Research Topics
- Self-assembly of nanostructures
- Spintronics
- Quantum computing
- Architectures for nanoelectronics and circuit design
- Quantum devices and single electronics
- Hot carrier transport in submicron devices and quantum wires
- Nanoelectronics

Dr. Alen Docef
Associate Professor
E-mail: adocef@vcu.edu
Phone: (804) 827-7032
Fax: (804) 827-0006
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=12
Research Topics
- Signal processor architectures
- Document compression for archiving
- Efficient, error-resilient, network-optimized image and video coding
- Medical image processing

Dr. Vennie A. Fillipas
Associate Professor, Associate Dean for Undergraduate Studies
E-mail: avfilippas@vcu.edu
Phone: (804) 827-3996
Fax: (804) 827-0006
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=17
- Numerical analysis techniques and software development for analysis and design of microwave and RF structures
- Signal processing and nonlinear statistical analysis techniques

Dr. Xubin He
Associate Professor
Email: xhe2@vcu.edu
Phone: (804) 828-0181
Fax: (804) 827-0006
Research Topics
- Computer architecture
- High availability computing
- High performance and reliable I/O systems
- I/O architecture and data storage
- Cluster virtualization

Dr. Rosalyn S. Hobson
Associate Dean for Graduate Studies
Associate Professor of Electrical Engineering
E-mail: rhobson@vcu.edu
Phone: (804) 828-8308
Fax: (804) 828-9866
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=110
- Medical image and signal processing
- Artificial neural network applications
- Science and technology in international development

Dr. Ashok Iyer
Professor and Chair
E-mail: aiyer@vcu.edu
Phone: (804) 827-7035
Fax: (804) 827-0006
Website: http://www.people.vcu.edu/~aiyer/
Research Topics
- GPS applications
- Neural networks
- Linear and nonlinear control theory
- Robotics for nuclear waste handling

Dr. Robert H. Klenke
Associate Professor
E-mail: rhklenke@vcu.edu
Phone: (804) 827-7007
Fax: (804) 827-0006
Website: http://www.people.vcu.edu/~rhklenke/
Research Topics
- Hardware/software system design
- Embedded system performance modeling and design
- Unmanned aerial vehicle (UAV) flight control system design and testing
- UAV payload design, integration, and testing

Dr. Robert J. Mattauch
Dean Emeritus and Commonwealth Professor
E-mail: robert.mattauch@gmail.com
Phone: (804) 334-8245
Website: http://www.egr.vcu.edu/Faculty Detail.aspx?facid=43

Dr. James M. McCollum
Assistant Professor
E-mail: jmmccollum@vcu.edu
Phone: (804) 828-0030
Fax: (804) 827-0006
Research Topics
- Computational biology
- Reconfigurable computer
- Stochastic simulation
- High-performance computing
- Digital systems design

Dr. Hadis Morkoc
Founders Professor
E-mail: hmorkoc@vcu.edu
Phone: (804) 827-3765
Fax: (804) 827-0006
Website: http://www.morkoc.vcu.edu
Research Topics
- Group III-V semiconductors
- Light emitting diodes
- Nitride semiconductor heterostructures

Dr. Yuichi Motai
Assistant Professor
E-mail: ymotai@vcu.edu
Phone: (804) 828-1281
Fax: (804) 827-0006
Website: http://www.egr.vcu.edu/FacultyDetail.aspx?facid=127
Research Topics
- Medical imaging
- Computer vision
- Robotics
- Human-computer interaction
- Online machine learning
- Adaptive target tracking

Dr. Umit Ozgur
Assistant Professor
Email: uozgur@vcu.edu
Phone: (804) 828-2581
Fax: (804) 827-0006
Website: http://www.engineering.vcu.edu/fac/ozgur
Research Topics
- Group III-nitride and zinc oxide optoelectronics
- Nonlinear optics
- Ultrafast spectroscopy
- Near-field optical microscopy
- Nanophotonics

Dr. Jerry H. Tucker
Associate Professor
E-mail: jhtucker@vcu.edu
Phone: (804) 827-7627
Fax: (804) 827-0006
Website: http://www.people.vcu.edu/~jhtucker
Research Topics
- Boolean equations and Boolean calculus
- Reconfigurable logic
- VHDL-based FPGA design
- Hardware and software for embedded microprocessor systems
- Parallel processing
- Computer architecture

Dr. Wei Zhang
Associate Professor
Phone: (804) 828-0181
Fax: (804) 827-0006
Research Topics
- Real-time and embedded systems
- Worst-case execution time (WCET) analysis
- Computer architecture and compiler
- Low-power computing

MECHANICAL

Dr. Stephanie G. Adams
Associate Professor
E-mail: sgadams2@vcu.edu
Phone: (804) 828-3925
Fax: (804) 828-9866
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_adams.html
Research Topics
- Teams and team effectiveness
- Engineering management
- Collaborative and active learning
- Engineering education and pedagogy

Dr. Ross Anderson
Associate Professor
E-mail: rcanderson@vcu.edu
Phone: (804) 827-4000
Fax: (804) 827-7030
Website: http://www.egr.vcu.edu/me/faculty/ME-anderson.html
Research Topics
- Probabilistic risk analysis
- Nuclear safety

Dr. Jayasimha Atulasimha
Assistant Professor
E-mail:jatulasimha@vcu.edu
Phone: (804) 828-9117
Fax: (804) 827-7030
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_atulasimha.html
Research Topics
- Nonlinear and hysteretic systems: dynamical response, development of inverse compensation, and control design
- Experimental control in aerospace, automobile, and biomedical applications (planned)
- Magnetostrictive, piezoelectric, and magnetoelectric materials
- Design and fabrication of MEMS devices
- Behavior of smart materials at micro/nano scale (planned)

Dr. Mohamed Gad-el-Hak
Caudill Eminent Professor
E-mail: gadelhak@vcu.edu
Phone: (804) 828-3576
Fax: (804) 827-7030
Website: http://www.people.vcu.edu/~gadelhak/
Research Topics
- Fluids in motion
- Flow control
- Viscous pumps and microturbines
- Microtechnology

Dr. Brian Hinderliter
Associate Professor
Phone: (804) 828-9117
Fax: (804) 827-7030
Research Topics
- Simulation of composite material's response to electromagnetic fields, stress and strains, and mass transport to emulate environmental degradation
- Mechanisms of polymer coating degradation and corrosion initiation
- Nuclear power plant design, thermal hydraulics, and radiation transport for shielding design
- Health and safety aspects related to health physics

Dr. Muammer Koç
Associate Professor
Director of NSF I/UCRC Center for Precision Forming
E-mail: mkoc@vcu.edu
Phone: (804) 827-7029
Fax: (804) 827-7030
Website: http://www.mdm-lab.vcu.edu
Research Topics
- Manufacturing processes and systems
- Product and process design
- Micro/nano-manufacturing
- Design and manufacturing of alternative energy devices (such as fuel cells) and medical devices
- Design and manufacturing of nano/micro-scale functional surface structures
- Deformation mechanics, tribology, and process in material forming plasticity
- CAE applications in design and manufacturing

Dr. P. Worth Longest
Associate Professor
E-mail: pwlongest@vcu.edu
Phone: (804) 827-7023
Fax: (804) 827-7030
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_longest.html
Research Topics
- Multiphase biofluid transport with applications to respiratory and cardiovascular therapies
- Transport of toxic and therapeutic aerosols and vapors in the respiratory tract
- Multiscale modeling of respiratory dosimetry down to the cellular level
- Development of next-generation inhalation devices for therapeutic aerosol delivery
- Simulating the role of particle hemodynamics in vascular diseases
- Microcirculation transport and thrombosis occlusion models
- Optimal design of vascular prostheses (grafts and stents)

Dr. James T. McLeskey Jr.
Associate Professor
E-mail: jtmcleskey@vcu.edu
Phone: (804) 827-7008
Fax: (804) 827-7030
Website: http://www.engineering.vcu.edu/ecsl/index.html
Research Topics
- Photovoltaic materials and devices
- Power generation
- Energy conversion systems
- Engineering education
- Optical characterization of semiconductor materials

Dr. Manu Mital
Assistant Professor
E-mail: mmital@vcu.edu
Phone: (804) 828-4267
Fax: (804) 827-7030
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_mital.html
Research Topics
- Micro/nano-scale heat transfer
- Heat transfer in biological systems
- Thermal management of electronic equipment
- Artificial intelligence and neural networks

Dr. Karla Mossi
Associate Professor and Graduate Program Director
E-mail: kmmossi@vcu.edu
Phone: (804) 827-5275
Fax: (804) 827-7030
Website: http://www.people.vcu.edu/~kmmossi/
Research Topics
- Electrical and mechanical characterization of smart materials and their applications in aerospace, automotive, medical, and electrical fields
- Materials and their response to different environments and the variation of their properties under different temperatures and boundary conditions (fluid mechanics, controls, equivalent circuits, mechanic of materials, etc.)
- Energy scavenging using pyroelectric and piezoelectric materials for low-power electronics

Dr. Ramana Pidaparti
Professor
E-mail: rmpidaparti@vcu.edu
Phone: (804) 827-3742
Fax: (804) 827-7030
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_pidaparti.html
Research Topics
- Design innovation through arts
- Computational mechanics
- Fatigue and fracture
- Biological composites
- Design engineering
- Neural networks and computational intelligence
- Nanotechnology and biomolecular motors
- Smart materials and structures

Dr. John E. Speich
Associate Professor and Associate Chair
E-mail jespeich@vcu.edu
Phone: (804) 827-7036
Fax: (804) 827-7030
Website: http://www.engineering.vcu.edu/fac/speich/website/
Research Topics
- Smooth muscle biomechanics
- Developing robotic devices for medical applications

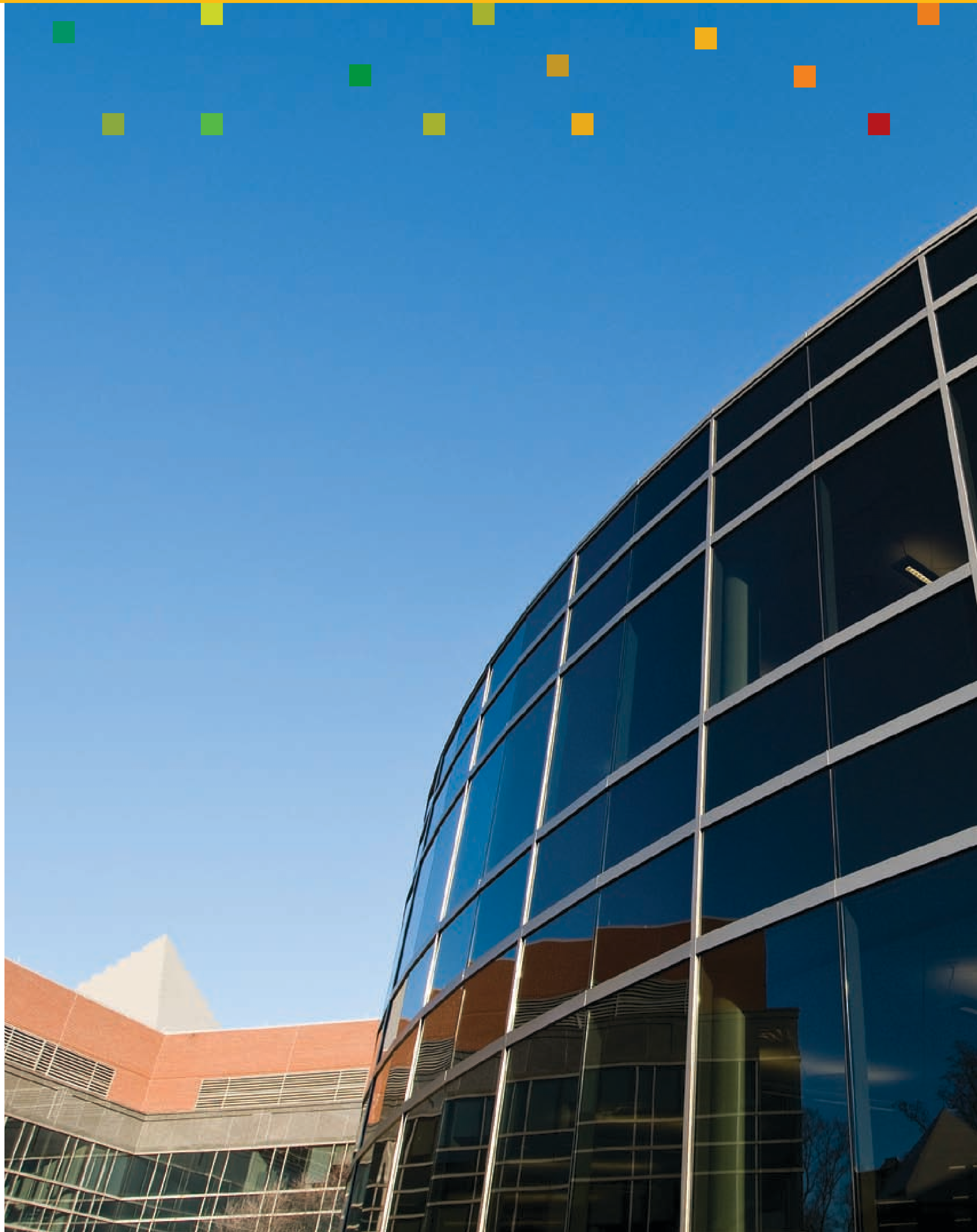
Dr. Vishnu Sundaresan
Assistant Professor
E-mail: vsundaresan@vcu.edu
Phone: (804) 827-7025
Fax: (804) 827-7030
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_sundaresan.html
Research Topics
- Applied membrane biophysics
- Active implantable material systems

Dr. Hooman Tafreshi
Qimonda Assistant Professor
Email: htafreshi@vcu.edu
Phone: (804) 828-9936
Fax: (804) 827-7030
Website: http://www.people.vcu.edu/~htafreshi
Research Topics
- Modeling and experiment on water jets and nozzle cavitation
- Aerosol flows and nanoparticle filtration
- Nanoparticle focusing and deposition
- Fluid transport in fibrous porous media
- Heat and mass transfer
- Molecular dynamics simulation of granular materials

Dr. Gary C. Tepper
Professor and Interim Chair
E-mail: gtepper@vcu.edu
Phone: (804) 827-4079
Fax: (804) 828-3846
Website: http://www.egr.vcu.edu/me/faculty/me-faculty_tepper.html
Research Topics
- Chemical and biological sensors
- Nanomaterials
- Molecularly imprinted polymers
- Radiation detectors
- Supercritical fluids
- Electroprocessing of polymers

Dr. Amy L. Throckmorton
Qimonda Assistant Professor
Email: althrock@vcu.edu
Phone: (804) 827-2278
Fax: (804) 827-7030
Website: http://www.people.vcu.edu/~althrock
Research Topics
- Experimental and computational fluid dynamics
- Turbomachinery design and applications
- Bench-to-bedside development of medical devices
- Artificial organs research, especially for the pediatric population
- Prediction and quantification of blood trauma and thrombosis in medical devices
- Cardiovascular modeling and univentricular Fontan physiology

VCU SCHOOL OF ENGINEERING FOUNDATION BOARD OF TRUSTEES



VCU School of Engineering
Virginia Commonwealth University

601 West Main Street
P.O. Box 843068
Richmond, VA 23284-3068

www.egr.vcu.edu