VOL. 8, No. 1

BIOFEEDBACK

THE FISCHELL DEPARTMENT *of* BIOENGINEERING
A. JAMES CLARK SCHOOL *of* ENGINEERING

www.bioe.umd.edu

A NEWSLETTER FOR ALUMNI AND FRIENDS OF THE FISCHELL DEPARTMENT OF BIOENGINEERING AT THE A. JAMES CLARK SCHOOL OF ENGINEERING, UNIVERSITY OF MARYLAND, COLLEGE PARK.

IN THIS ISSUE:

FDA Awards University of Maryland New Center for Regulatory Science

NEW CENTER: FDA CHIEF SCIENTIST **JESSE L. GOODMAN** (CENTER) ANNOUNCED THE NEW REGULATORY CENTER AND DISCUSSED ITS GOALS AT THE 2011 FISCHELL FESTIVAL *(SEE RELATED STORY, P. 10)*. GOODMAN IS SEEN HERE AT THE FESTIVAL WITH BIOENGINEERING PROFESSOR AND CHAIR **WILLIAM E. BENTLEY** (LEFT) AND DR. **ROBERT E. FISCHELL** (RIGHT). *PHOTO BY LUISA DIPIETRO, ESSENTIAL EYE PHOTOGRAPHY.*

The University of Maryland has created a new Center of Excellence in Regulatory Science and Innovation (CERSI), funded by an initial $1 million grant from the U.S. Food and Drug Administration. The center will focus on modernizing and improving the ways drugs and medical devices are reviewed and evaluated.

The new center will be a collaborative partnership between the University of Maryland, College Park, and the University of Maryland, Baltimore. Researchers from both campuses will work with FDA scientists to develop new tools, standards and approaches to assess the safety, efficacy, quality and performance of FDA-regulated products.

"Maryland's CERSI will draw from University of Maryland expertise on both the College Park and Baltimore campuses and create new mechanisms for scientific exchange, education and training, and regulatory science research," says Fischell Department of Bioengineering chair **William E. Bentley**, the Robert E. Fischell Distinguished Professor of Engineering. Bentley and **James Polli**, the Shangraw/Noxell Endowed Chair in Pharmaceutical Sciences at the University of Maryland School of Pharmacy, are co-principal investigators on the initiative.

"Collectively, FDA, industry, and academic scientists all recognize the need for new tools in drug discovery and development, such as a series of new laboratory tests or software, in order to anticipate safety and efficacy of drugs in development," says Polli.

Center researchers will assist the FDA in driving innovation in medical product development, as well as in advancing laboratory, population, behavioral and manufacturing sciences.

"These partnerships represent a critical, necessary and creative investment–one that will benefit not just FDA and academia, but also American consumers and industry," says

continues pg. 2

chair's MESSAGE

WILLIAM BENTLEY

THINGS ARE MOVING RAPIDLY—ALMOST TOO RAPIDLY TO KEEP YOU INFORMED ON A TIMELY BASIS!

We're moving up in the rankings. Last year's National Research Council ranking put the graduate program at the #14 slot overall. This year *U.S. News & World Report* (which doesn't use data, believe it or not), put the undergraduate program and department at #30—and we've only had three classes of graduating seniors! We were at #43 two years ago.

We're still growing, too. We're wrapping up our latest faculty search, and I'm also pleased to announce that Tracy Chung, Ph.D., has joined us as our new Director of Academic and Student Affairs. Tracy comes to us from the Department of Electrical & Computer Engineering, where she very successfully oversaw one of the largest graduate programs on campus. She's working closely with Associate Chairs John Fisher and Peter Kofinas to ensure that our students are immersed in the right environments and getting the most out of their ever-expanding programs.

Our big stories this issue are about the launch of our new U.S. Food and Drug Administration (FDA) Center for Excellence in Regulatory Science Innovation, in partnership with the University of Maryland, Baltimore *(see our cover story)*; and our partnership with Canon U.S. Life Sciences to develop a system for the simple and rapid diagnosis of infectious diseases *(see back cover and p. 7)*. Both of these collaborations were designed to take amazing innovations, from both academia and industry, from lab to clinic.

So many great things are happening, we can't wait to send you our next issue! But you don't have to wait—you can always get the latest news at bioe.umd.edu/news.

With Best Regards,

William E. Bentley
Robert E. Fischell Distinguished Professor and Chair

CERSI, continued from page 1

FDA Chief Scientist **Jesse L. Goodman.** "The Centers of Excellence will create new scientific research, training and staff exchange opportunities for FDA and leading area institutions."

The University of Maryland center will focus on three key FDA priorities: 1) improving pre-clinical assessments of the safety and efficacy of new drugs and devices; 2) ensuring readiness to evaluate innovative and emerging technologies; and 3) harnessing diverse data through information sciences to improve health outcomes. Maryland researchers will address pre-clinical assessment challenges related to membrane transporters in drug development, hepatotoxicity biomarkers and personalized medicine, as well as device evaluation related to optical imaging, materials such as nanostructured polymeric coatings for stents and grafts, and tissue engineering.

The new UMD/UMB center also will sponsor seminars and workshops, as well as an open public forum to promote regulatory science exchange, bringing together a network of experts from academia, industrial consortia and FDA scientists.

"This innovative new center will improve the lives of Americans," says **Patrick O'Shea**, vice president for research at the University of Maryland, College Park. "The University of Maryland's researchers will help the FDA transform the way that drugs and devices are evaluated and influence how they are designed, developed, manufactured and brought to market."

The FDA also awarded $1 million to Georgetown University for a sister regulatory science and innovation center. According to the FDA, the agency chose to pilot the two centers in the Washington, D.C., area to allow for the greatest possible face-to-face collaboration and training with FDA staff.

$1.35 MILLION TO FISHER LAB FOR DEVELOPMENT OF BONE REGENERATION TECHNOLOGY

A proposal to advance the development of a system for regenerating large areas of bone in patients with serious injuries has received a four year, $1.35 million grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases, part of the National Institutes of Health (NIH). BioE Associate Professor and Associate Chair **John Fisher** is the lead investigator on the project, which seeks to provide cultured tissue with a better blood supply and more structural support after implantation.

In 2009, Fisher and members of his Tissue Engineering and Biomaterials Laboratory designed a novel, patent-pending bioreactor system that makes tissue engineering more efficient by exposing proliferating cells to an increased amount of oxygen and nutrients. The bioreactor is also more cost-effective, thanks to its use of off-the-shelf components.

While the efficacy of the bioreactor system has been demonstrated, additional challenges associated with implanting the new tissue, particularly over large areas, remain.

"When you engineer a large area of new bone tissue it needs a blood supply," explains BioE Ph.D. candidate **Andrew Yeatts**, who works with Fisher on the project. "The body will naturally grow new blood vessels, but too slowly for the implanted tissue to survive. Another problem is the need for load-bearing support during the healing process. We grow our bone tissue in beads made out of a natural polymer called alginate. The cells do very well in it, but it doesn't have sufficient mechanical strength. If an injury is not in a substantial load-bearing region you can add filler tissue to the site to help it regenerate. But if the injury is a broken thigh bone, for example, the new tissue is going to need to be housed in a strong construct to ensure everything stays in place and heals true to form."

To solve these problems, Fisher, Yeatts and their collaborators have introduced two innovations into the bone repair process: The first is the creation of a pre-vascular network within the tissue culture that will lay the groundwork for the construction of new blood vessels. The second is the use of a strong, synthetic biodegradable polymer, poly(propylene fumarate) (PPF), as a carrier and scaffold for the new tissue that can be custom fit to the shape of the injury.

The team plans to incorporate endothelial cells, which line blood vessels, into the bioreactor system with the growing bone cells. There, they will naturally begin to organize into a prevascular network. Once implanted, the cells will have a head start on forming new blood vessels, and can also signal other endothelial cells nearby, encouraging existing blood vessels to penetrate the new tissue, where the two networks will connect.

When the new tissue is ready, the alginate beads containing it will be transferred from the bioreactor into hollow regions of a rigid PPF scaffold. Nesting the cells in two environments creates a complimentary solution in which the best growth conditions are surrounded by the best structure.

In their proposal, Fisher and his colleagues have outlined a plan to construct the scaffolds using a process called stereolithography, also known as rapid prototyping or "3-D printing," which is already sometimes used by surgeons preparing to implant plastic or metal in place of bone. After scanning the injury site, the process will be used to interpret the data and build a perfectly matched replacement for the missing bone made out of PPF.

"The PPF scaffold will support the load, slowly degrading over the course of months until it is replaced with the patient's native bone in the same shape," says Yeatts.

Fisher and Yeatts will perform the work in collaboration with **David Dean** (Department of Neurological Surgery, Case Western Reserve University) who specializes in stereolithography; and **Eric Brey** (Department of Biomedical Engineering, Illinois Institute of Technology), who specializes in endothelial cell cultures.

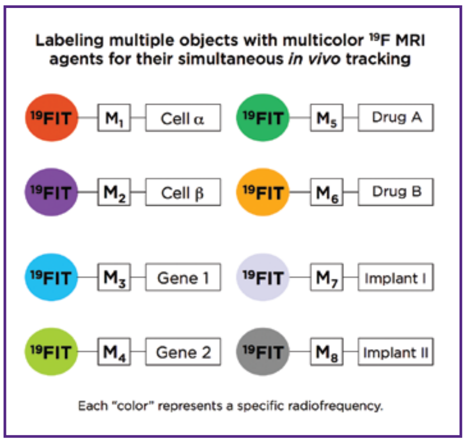
YU AIMS TO MAKE MULTICOLOR MRI A REALITY

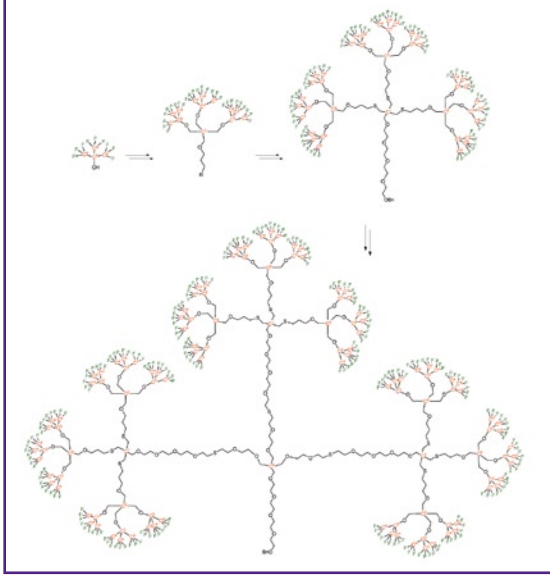
Associate Professor **Bruce Yu** (joint, University of Maryland School of Pharmacy) is developing novel biomaging agents that could lead to safe, clear, multicolor magnetic resonance images. The new technique would allow doctors to simultaneously track multiple drugs or physiological events in their patients.

The project, funded by a grant from the National Science Foundation, builds on Yu's previous work with fluorine magnetic resonance imaging (^{19}F MRI), a specialized form of MRI used to visualize drugs, cells, genes, or implants administered to a patient for therapeutic reasons. In an earlier study, Yu and his colleagues developed a new imaging agent for use in ^{19}F MRI that provides clearer images with less background noise, and passes quickly and safely out of the body, thereby addressing two problems currently hindering the use of ^{19}F MRI in clinical settings.

Those results are now being applied to the development of multichromic ^{19}F MRI, in which multiple therapeutics can be tracked simultaneously by assigning each its own imaging agent that causes it to emit a different radiofrequency signal than the others. Each signal is assigned a particular color in the resulting images (a process called pseudo-coloring), generated by a device called a fluorometer.

Yu and his colleagues are designing particles called fluorinated paramagnetic complexes (FPCs) that will create the customized signals. The FPCs consist of three parts: the fluorine (^{19}F), which is responsible for emitting a signal when excited by a magnetic pulse; metal ions, which modulate the ^{19}F signals to the desired frequencies; and chelators, organic molecules used to safely contain the metal ions, which are toxic.





TREE-LIKE MOLECULES FOR ^{19}F IMAGING. ASSOCIATE PROFESSOR **BRUCE YU'S** GROUP DEVELOPED A NEW STRATEGY, CALLED TWO-WAY GROWTH, TO MAKE DENDRIMERS GROW IN A TREE-LIKE FASHION. TWO-WAY GROWTH OVERCOMES STERIC CONGESTION ENCOUNTERED IN CONVENTIONAL ONE-WAY GROWTH DENDRIMER SYNTHESIS. USING THIS STRATEGY, YU'S GROUP MADE DENDRIMERS CONTAINING UP TO 243 IDENTICAL FLUORINE ATOMS FOR ^{19}F MRI. THE UNIVERSITY OF MARYLAND HAS FILED A PATENT APPLICATION BASED ON THIS WORK.

Generating signals that can be interpreted as different colors is only half of the problem. Because of the inherent difficulty in receiving a clear, lasting signal from only one agent, working with a "full palette" multiplies the challenge.

The key to the new multicolored images, Yu explains, lies in the two novel ways he and his team are using the metal ions: They are assigning each class of FPC a different type of metal ion, which modulates the radiofrequency signal generated by the 19F nucleus in a distinct way (traditional MRI techniques use only one kind of ion, gadolinium); and they are arranging each FPC's chelator-wrapped ions in a way that also turns them into a magnetic shield, protecting the fluorine from outside influences—including other FPCs—that could change its signal.

continues pg. 4

MULTICOLOR MRI, continued from page 3

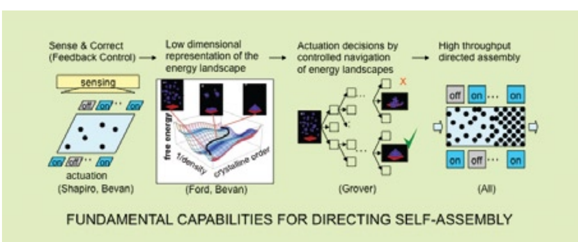
"In multichromic MRI, the critical thing is to maintain the stability of the resonance frequency of each imaging agent," Yu explains. "In other words, the 'color' of each imaging agent should not change over time. We envision that symmetrically arranged metal ion-chelates can form a magnetic shield around the ^{19}F signal emitter, which should prevent fluctuations in the local magnetic environment from interfering with its resonance frequency."

Yu's proposal, "Engineering Fluorinated Paramagnetic Complexes for Multichromic ^{19}F MRI," is funded by a three year, $542,000 grant from the National Science Foundation's Biophotonics, Advanced Imaging, & Sensing for Human Health Program. The study will be conducted in collaboration with Professor **Eun-Kee Jeong** of the Department of Radiology, University of Utah.

SHAPIRO ON NANOTECH TEAM FOR ASSEMBLY OF COLLOIDAL CRYSTALS

Associate Professor **Benjamin Shapiro** (joint, Institute for Systems Research) is a co-PI on a new National Science Foundation grant to develop tools that could mass-produce revolutionary materials for future technologies such as optical computing, energy harvesting, sub-diffraction limit imaging and invisibility cloaking.

"First-Principles Based Control of Multi-Scale Meta-Material Assembly Processes" is a four-year, $1.2 million Collaborative Research Cyber-Enabled Discovery and Innovation Type II grant that focuses on precisely controlling ensembles of colloidal nanoparticles to create defect-free crystals for optoelectronic metamaterials, in a way that has the potential to scale up to fabrication.



FUNDAMENTAL CAPABILITIES FOR DIRECTING SELF-ASSEMBLY

Such a development could have a similar revolutionary effect as the creation of single crystal silicon, which enabled integrated circuits and modern computing.

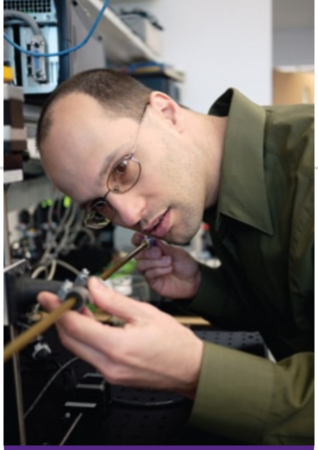
The research combines Shapiro's lab capabilities in micro/nano feedback control with the colloids' real-time imaging and experiments conducted by **Michael Bevan** at Johns Hopkins University; the statistical mechanics modeling of energy surfaces and arrested states of Principal Investigator **David Ford** at the University of Massachusetts Amherst; and the control and model reduction methods for statistical ensembles of **Martha Grover**, Georgia Institute of Technology.

The assembly of colloidal nano- or micro-particles into perfectly ordered periodic structures provides a basis for manufacturing photonic band gap materials and other multi-scale meta-materials with unique electric, magnetic, and optical properties. Although proof-of-concept materials have been made in laboratories to verify their properties, no existing process is sufficiently controllable, scalable, and robust for high-throughput manufacturing to enable commercial applications. Twenty-five years of trial-and-error efforts have limited progress so far. A strategy of rigorous real-time control using quantitatively accurate process models, which is the focus of this research, is required.

The fundamental limitation to assembling colloidal components into ordered structures is the complex interplay of thermal motion, interparticle interactions, and external fields that lead to defect-rich and often arrested states.

The research will develop a new approach to the meta-material assembly problem that combines expertise from four separate scientific fields that traditionally have had minimal interaction.

Mathematical models of the colloidal systems, represented as free energy landscapes (FELs) in a few key variables that characterize


BENJAMIN SHAPIRO

the state of the assembly process, will be constructed using data from advanced microscopic imaging and analysis tools. The FELs will in turn be used as input to rigorous process control algorithms, developed for stochastic processes, that will navigate the landscapes to yield defect-free products. This strategy will be demonstrated and refined on prototype lab-scale reactors, using real-time digital microscopic imaging as the sensor and programmable particle-particle interaction potentials and electric fields as the actuators, to produce meta-materials.

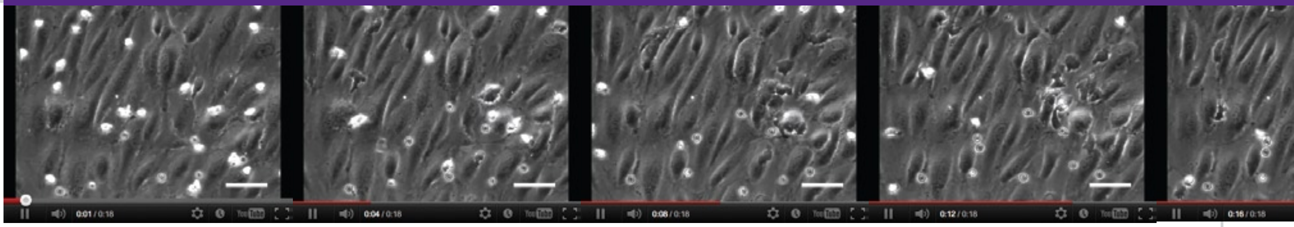
NOVEL BIOPHYSICAL MODELS HELP EXPLAIN MECHANICS OF CARDIOVASCULAR DISEASE

Novel *in vitro* biophysical models designed in the Fischell Department of Bioengineering (BioE) that help explain how mechanical changes in blood vessel behavior cause a cascade of effects leading to the progression of cardiovascular disease have been featured in *Blood,* a high-impact journal produced by the American Society of Hematology and the most cited peer-reviewed publication in its field. BioE graduate student (now alumna) **Kimberly Stroka** and her advisor, Associate Professor **Helim Aranda-Espinoza**, produced the results.

Leukocytes, also known as white blood cells, are the human immune system's first line of defense, called to respond to injury and fight disease. In order to travel to the site of an infection they must exit the bloodstream by crossing the endothelium, the single layer of cells lining our blood vessels, using a process known as transmigration. Ironically, the cells designed to protect us from harm may unintentionally contribute to the development of atherosclerosis, a form of cardiovascular disease, as they go about their business.

Atherosclerosis is associated with the stiffening of the blood vessels' subendothelial matrix, the surface to which the endothelial cells are attached. The number of leukocytes

FRAMES FROM A MOVIE MADE FROM A PHASE CONTRAST MICROSCOPY SEQUENCE OF HUMAN LEUKOCYTES (WHITE BLOOD CELLS) MIGRATING ALONG AND TRANSMIGRATING THROUGH AN ENDOTHELIAL CELL MONOLAYER. ENDOTHELIAL CELLS ARE THE LARGER, DARKER CELLS IN THE BACKGROUND. LEUKOCYTES ARE THE SMALLER, BRIGHT WHITE CELLS WHILE ON TOP OF THE ENDOTHELIUM. AS THE LEUKOCYTES TRANSMIGRATE, THEY DARKEN IN PHASE CONTRAST MICROSCOPY, ALLOWING US TO EASILY OBSERVE THE PROCESS. THE SCALE BAR IS 50 MICRONS.



attempting to transmigrate increases in these compromised surroundings. Many of them become stuck and subsequently damaged, building up into a plaque that could block a blood vessel, causing a stroke or heart attack.

Stroka and Aranda-Espinoza hypothesized that as the endothelial cells "feel" the matrix stiffen beneath them, they undergo biophysical changes in response that negatively affect leukocyte transmigration, creating this risky situation.

To study these behaviors under controlled conditions, they created a new kind of model blood vessel. They started with hydrogels of varying stiffness to represent human examples of the subendothelial matrix that were too soft, healthy, and hard enough to be associated with cardiovascular disease. A monolayer of endothelial cells was grown on each of the gels' surfaces to create an endothelium. After inducing an inflammatory response in the endothelial cells, they added human leukocytes, and used time-lapse microscopy to observe their transmigration, live and in real-time.

Although it is known that patients suffering from atherosclerosis experience an increase in the number of leukocytes attempting to transmigrate, what has not been clear is whether this initiates the disease or is a response to it, because it also isn't known whether the disease causes the stiffening or the stiffening causes the disease. Using their models, Aranda-Espinoza and Stroka may have discovered an important clue.

"The endothelial cells contract in response to the stiffening of the subendothelial matrix," Stroka explains. "It's like playing tug-of-war on pavement versus a mud pit. It's easier to get traction on the hard ground. These contractile forces open larger intercellular gaps. What our paper is suggesting is that the stiffening is making the disease worse by disrupting endothelial cell barrier function and allowing too many leukocytes to pass through."

Stroka says their study paves the way for related research, such as whether subendothelial matrix stiffness affects the transmigration of other cell types, including metastatic cancer cells. She's also optimistic that what they've learned could lead to new approaches in diagnosis and treatment, such as identifying stiffening in the matrix before its most deadly symptoms, a heart attack or stroke, occur, or through treatments that restore elasticity to stiffened blood vessels before plaques can form.

The research has been funded by the National Institutes of Health and the National Science Foundation.

For more information, see "Endothelial cell substrate stiffness influences neutrophil transmigration via myosin light chain kinase-dependent cell contraction," Kimberly M. Stroka and Helim Aranda-Espinoza, Blood, 118(6)

recent DISSERTATIONS

AUGUST 2011

Joshua Chetta: "Cytoskeletal Mechanics and Mobility in the Axons of Sensory Neurons." Advisor: Sameer Shah.

Christina Kyrtsos: "Of Mice and Math: A Systems Biology Model for Alzheimer's Disease." Advisor: John Baras (Department of Electrical & Computer Engineering and Institute for Systems Research).

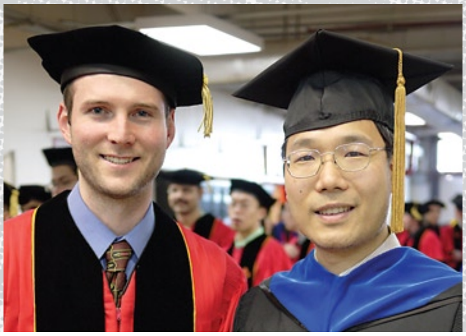
Michael Morschauser: "Development of Collagen Thin Films for Intervertebral Disc Cell Culture & Examination of Cell Phenotypes and Interactions." Advisor: Adam Hsieh.

DECEMBER 2011

David Hwang: "Effects of Load History on Intervertebral Disc Mechanics and Cellular Function." Advisor: Adam Hsieh.

Kimberly M. Stroka: "Biophysical Aspects of Leukocyte Transmigration through the Vascular Endothelium." Advisor: Jose Helim Aranda-Espinoza.

Jeremiah J. Wierwille: "Multi-Modal, Multi-Parametric Optical Imaging of Kidney *In Vivo*." Advisor: Yu Chen *(below with Wierwille, on right)*.



alumniNEWS

Former Fischell Fellow **Dan Janiak** (B.S. '04 and Ph.D '09, materials science and engineering) has joined the staff of DFJ Mercury, a seed-stage venture capital firm based in Houston, Tx., specializing in technology transfer and incubation.

Chris Perrygo (M.S. '00, biological resources engineering) has been appointed Executive Director of Sabre Systems, Inc., a technology solutions company that provides IT support, engineering, program management, software development and training to its clients. In his new role, he will oversee the IT and information management support team that serves the Naval Air Systems Command (NAVAIR) in Patuxent River, Md., while continuing to provide program management support to other IT and software engineering projects.

HEROLD HELPS 1ST PLACE SOLAR DECATHLON TEAM SHINE

When Secretary of Energy **Steven Chu** announced that the University of Maryland's solar house *(below)* had placed second in the final component of the Department of Energy's ten-part Solar Decathlon–the market appeal contest–everyone cheering in the main tent in West Potomac Park, Washington, D.C., knew that taking first place overall was all but assured for Maryland.

That's exactly how it played out: 3rd place for New Zealand, 2nd for Purdue University, and 1st place for Maryland in a competition involving twenty teams from around the world. The elated Maryland team received the big silver trophy and returned to WaterShed, the 800 square foot solar-powered home they had designed and built over the preceding two years, to continue the celebration.

The over 200 students of Team Maryland–representing departments from across the university–were guided in their efforts by a dedicated group of professors and mentors led by School of Architecture professor **Amy Gardner** and Fischell Department of Bioengineering associate professor **Keith Herold**. Herold worked with a group of 20-30 students who played a key role in the design, construction and operation of the WaterShed house systems.

"I got involved because I enjoy working with students, and because this project ties in with the energy system work I did for many years prior to joining BioE," he says. The long hours and long meetings, he adds, were offset by working with students he describes as "some of our best and brightest."

"[Working on the Solar Decathlon team] is a great opportunity for students to learn in a more realistic environment than a traditional classroom," he says. "A multidisciplinary project like this requires many perspectives and it is a challenge to appreciate them all."

Herold cites WaterShed's liquid desiccant system and overall design that integrates the conservation and production of resources, particularly in the collection and handling of water, as features which made the home unique among the field of entries. WaterShed is described by Team Maryland on its web site as "…a micro-scale ecosystem, emulating the environment of the Chesapeake Bay watershed" in which plants in the landscaping, on the green roof, and in the garden are "part of the house's living systems, which produce food and store, purify, and manage water."

Clark School Dean **Darryll Pines** congratulated Gardner and Herold, who "put their hearts and souls into this project" on behalf of the University of Maryland. "Keith worked non-stop ensuring that we met all of our efficiency goals," he added, "including achieving net zero off the grid to tie for first in the energy balance category."

To learn more, visit **solardecathlon.gov** *and* **2011.solarteam.org**.

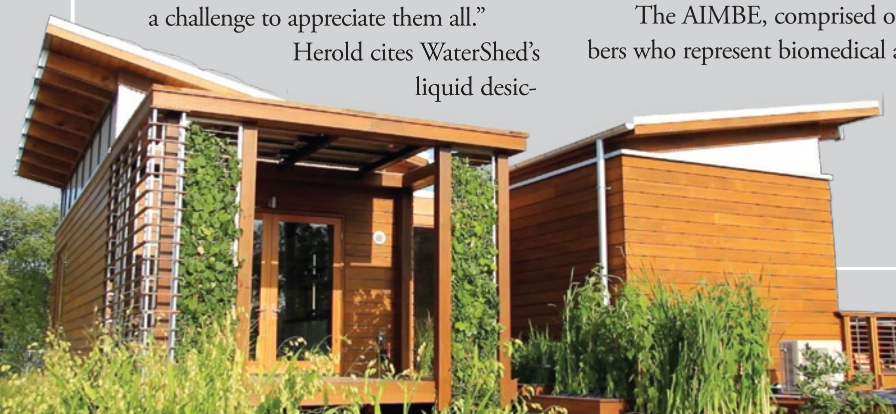
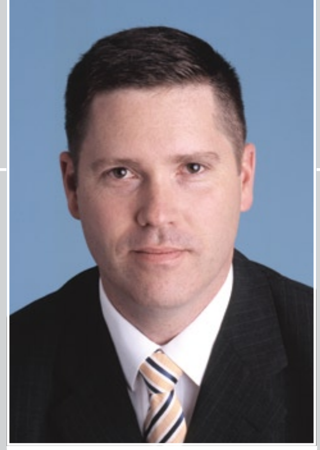


PHOTO BY JOHN T. CONSOLI

FISHER ELECTED FELLOW OF THE AIMBE



JOHN FISHER

Fischell Department of Bioengineering associate professor and associate chair for undergraduate studies **John Fisher** has been elected to the American Institute for Medical & Biological Engineering's (AIMBE) College of Fellows. He was cited for "outstanding contributions to the development of engineered tissues based upon the control of paracrine signaling among biomaterial-embedded cell populations." Fisher was formally inducted at a ceremony held during AIMBE's 21st Annual Event in Washington, D.C. in February 2012.

The AIMBE, comprised of 50,000 members who represent biomedical and biological engineering communities in academia, industry, and professional societies, advocates for the advancement of the field by advising in policy and product development, communicating with government agencies, promoting investment in biomedical and biological engineering research and products, inspiring future scientists, and honoring notable achievements. The Institute's College of Fellows is considered to represent the top 2% of the medical and bioengineering community.

Fisher, who earned his Ph.D. in bioengineering from Rice University in 2003, joined the University of Maryland that same year as an assistant professor in the Department of Chemical and Biomolecular Engineering. He received a NSF-CAREER award in 2005 for his work on establishing the relationship between biomaterial properties and endogenous cell signaling. In 2006 he joined the newly formed Fischell Department of Bioengineering, and was promoted to associate professor in 2008.

Fisher has established himself as a preeminent researcher in the biomaterials and tissue engineering communities for his work in bone regeneration and cartilage repair, including new techniques for craniofacial reconstruction and growing implantable tissue. His work has been sponsored by millions of dollars in grants from the National Institutes of Health, the Arthritis Foundation, and the Maryland Stem Cell Research Fund. His development of biomaterials that resist premature degradation won the UM Office of Information Office of Technology Commercialization's Life Science Invention of the Year award in 2005, and an efficient, cost-effective bioreactor system developed in his lab won the Best Inventor Pitch at the university's 2009 Professor Venture Fair. Fisher is the director of the Tissue Engineering and Biomaterials Laboratory and the PI of the department's highly competitive, National Science Foundation-sponsored Research Experience for Undergraduates program on Molecular and Cellular Bioengineering. He

HIROSHI INOUE, FOUNDER OF CANON U.S. LIFE SCIENCES, WAS INDUCTED INTO THE FACULTY AS A PROFESSOR OF THE PRACTICE. LEFT TO RIGHT: DISTINGUISHED UNIVERSITY PROFESSOR **RITA COLWELL**; UM PRESIDENT **WALLACE LOH**; **HIROSHI INOUE**; BIOE PROFESSOR AND CHAIR **WILLIAM E. BENTLEY**; AND CANON U.S.A. PRESIDENT AND CEO **YOROKU ADACHI**. *PHOTO BY JOHN T. CONSOLI.*

teaches courses in tissue engineering and the modeling of physiological systems. He also serves as an editor for *Tissue Engineering,* the leading journal in its field.

INOUE JOINS BIOE AS PROFESSOR OF THE PRACTICE

The Fischell Department of Bioengineering and the A. James Clark School of Engineering are pleased to welcome **Hiroshi Inoue** to its faculty as a Professor of the Practice. Inoue was inducted in a ceremony attended by Canon U.S.A. president and CEO **Yoroku Adachi**; BioE professor and chair **William E. Bentley**; past National Science Foundation director, National Academy of Sciences member, and Distinguished University Professor **Rita Colwell**; and University of Maryland president **Wallace Loh**. The event also celebrated the department's new collaboration with Canon *(see related story, back cover).*

Inoue, founder and senior fellow of Canon U.S. Life Sciences, Inc., is a key member of that new partnership. "I am honored and humbled by my appointment at the University of Maryland as Professor of the Practice," he says. "I expect that it will provide a powerful linkage between the Global Canon Group and the University of Maryland...I look forward to an ongoing relationship."

Inoue, a graduate of the Engineering Science School at Osaka University, Japan, has pioneered numerous and diverse technologies while working for some of the world's most prominent companies, including Seiko, Epson, Ricoh, and, since 1983, Canon. These include the development, market introduction and market expansion of novel flat-panel displays; the introduction of the ISO/IEC Standard into the MPEG-4 file format, which enables users to view video on smartphones; and genetic diagnostics systems. In 2004, he launched and served as the first president and CTO of Canon U.S. Life Sciences, Inc., which develops diagnostic instrumentation based on Canon's core technologies. Inoue holds almost 350 patents in Japan and the United States.

"We are honored to welcome Mr. Inoue to our faculty," says Bentley. "His accomplishments and experience embody Dr. Fischell's vision, and our department's goals, of using entrepreneurship to move innovative new devices from the lab into clinical settings."

ARANDA-ESPINOZA, HSIEH PROMOTED

Congratulations to **Helim Aranda-Espinoza** and **Adam Hsieh**, who have been promoted to the rank of associate professor with tenure.

Both professors were originally recruited for the Graduate Program in Bioengineering. Aranda-Espinoza joined the Clark School with an appointment in the Department of Chemical and Biomolecular Engineering in 2005, while Hsieh was appointed to the Department of Mechanical Engineering in 2004. In 2006, they were among the first full-time faculty members to join the newly established Fischell Department of Bioengineering.

Aranda-Espinoza received his Ph.D. from the Universidad de San Luis Potosi, Mexico, in 1998. He is the director of the Cell Biophysics Laboratory, which applies the theoretical and experimental machinery of physics and engineering to obtain a quantitative understanding of specific problems inspired by biological systems. The group studies the mechanics and motility of healthy cells, as well as those with pathological conditions. The group also seeks to understand how the mechanical environment dictates cell functions.

In 2007, Aranda-Espinoza received a National Science Foundation Faculty Early Career Development (NSF-CAREER) Award for his proposal to study how neurons migrate and axons elongate as a function of the mechanical properties of the substrate.

"Helim's scholarship and personal attention to the well-being of his graduate students is outstanding," says BioE professor and chair **William E. Bentley**. "He has been particularly successful in finding ways to get his students' research international exposure. Many of his group members have attended meetings in foreign countries."

Hsieh received his Ph.D. from the University of California, San Diego, in 2000. He is the director of the Orthopaedic Mechanobiology Lab, where he and his group study how specific exposures of mechanical stress in musculoskeletal tissues contribute to health and disease, with a particular focus on intervertebral discs of the spine. The group's goal is to understand how the cellular and tissue mechanical environment modulates biological response, so that preventive and therapeutic strategies against musculoskeletal disorders can be developed.

Hsieh is also a NSF-CAREER award winner, having received the honor in 2009 for a proposal to use RNA interference to customize mechanotransduction, the way that cells perceive and respond to mechanical stress, by either amplifying or reducing intercellular communication to achieve a desired result.

"Adam's research is stellar and his group is engaged and cohesive," says Bentley. "He cares deeply about the education process, both at the graduate and undergraduate levels. He was the first champion of our BIOE 121 class and got it off the ground. It is now the most important freshman course in terms of building a community among our freshmen students."

HSIEH (LEFT) AND ARANDA-ESPINOZA (RIGHT) ▶

RASA GHAFFARIAN

GHAFFARIAN WINS NANO-MEDICINE POSTER AWARD

Graduate student **Rasa Ghaffarian**, advised by Assistant Professor **Silvia Muro** (joint, Institute for Bioscience and Biotechnology Research), won the Best Poster Award at the third annual meeting of the American Society of Nanomedicine, held in Shady Grove, Md. in November 2011. Ghaffarian took top honors for the presentation of her work on a safer method of transporting drugs across the epithelial barrier lining the gastrointestinal (GI) tract.

In April 2011, Ghaffarian and Muro received the University of Maryland Office of Technology and Commercialization's Invention of the Year award in the Life Sciences category for their work in this area, which described how drug nanocarriers that target a protein found in the epithelial cells of the GI tract, ICAM-1, can prompt the cells to take up (ingest) and move the drugs using their natural vesicular transport mechanisms rather than using the more common method of forcing therapeutics through the junctions between them. This transport mechanism was observed to be safer than the intercellular junction route, which can allow other undesired molecules to pass through at the same time because it is like an unguarded door that doesn't "check ID."

At the conference, Ghaffarian presented advances in the project that describe how vesicular transport is regulated by a unique mechanism found to be distinct from other vesicular pathways previously described. This discovery will further guide the optimization and manipulation of the transport pathway to improve drug delivery across the GI tract.

Ghaffarian says she's excited about these recent results. "ICAM-1-targeting utilizes an innate mechanism of transport that has yet to be characterized," she explains. "The nature of vesicular, transcellular transport is not very well understood by the scientific community, so further characterization will allow us to exploit this pathway for drug delivery purposes as well as provide extremely valuable insight for fundamental cell biology."

XIE ADVOCATES FOR STUDENTS

The *Washington Post* and ABC News covered BioE senior and University of Maryland undergraduate student body president **Kaiyi Xie**'s efforts to represent the interests of his constituents in the nation's debt ceiling debate.

Xie, who also majors in mathematics, was a guest columnist in the *Post*'s "Campus Overload" blog ahead of President **Barak Obama**'s visit to campus in July 2011. In his post, Xie explained his role as one of a coalition of over 120 student body presidents called Do We Have A Deal Yet?, which is behind efforts to ensure that the concerns of young taxpayers are heard in Washington.

In an interview from Capitol Hill with ABC News' political show "Top Line," Xie expressed his support for the Gang of Six's efforts, urged bipartisanship and balance in finding a solution to the nation's mounting debt crisis, and emphasized that students do care about the debt debate and the effects it will have on their futures, including access to higher education, their ability to find jobs, and their ability to ultimately retire. Xie was at the Capitol representing the Do We Have A Deal Yet? coalition with Georgetown University student body president **Michael Meaney**.

Xie and Meaney's efforts paid off when they were able to secure a conference call with President Obama and members of his staff, including **Gene Sperling** (Director, National Economic Council and Counselor to Treasury Secretary Tim Geithner) and **Kalpen Modi** (Associate Director, Office of Public Engagement, better known as actor **Kal Penn**). Xie later met President Obama in person at the town hall meeting held on the University of Maryland campus. Xie reports that members of the coalition have also been able to speak to **Erskine Bowles** (co-chair, National Commission on Fiscal Responsibility and Reform) and have met with members of House of Representatives Minority Leader **Nancy Pelosi**'s staff.

MELCHIORRI: 2011 FISCHELL FELLOW

The Fischell Department of Bioengineering is pleased to anounce the newest recipient of the Fischell Fellowship in Biomedical Engineering, **Anthony Melchiorri**. The fellowship is awarded annually to talented and innovative graduate students interested in applied research and product design in the biomedical industry. Melchiorri is also the recipient of a National Science Foundation Graduate Research Fellowship and a Maryland Technology Enterprise Institute (Mtech) Citrin Fellowship.

Melchiorri, who earned a B.S.E in biomedical engineering and a B.A in English from the University of Iowa, was active in cardiovascular research throughout his undergraduate studies. As a freshman and sophomore, he studied nanoparticle applications in identifying and imaging mesenchymal stem cells after implantation, and the cells' subsequent cardiomyogenic differentiation.

In his junior year he studied Amplatzer® atrial septal occluders, devices designed to close holes in the heart, identifying factors that create risks when they are used in pediatric patients. Between his junior and senior years, Melchiorri was an intern at Cook, Inc., where he helped design a new research methodology to test drug-coated devices. His work with the company's biopsy tools resulted in several patent applications.

"I chose the Fischell Department of Bioengineering because of the variety of opportunities available to [its] graduate students," he says, citing its collaborations with major research labs such as the FDA and NIH. He was also impressed with Mtech's campus entrepreneurship programs. At Maryland, he hopes to continue to pursue research in cardiovascular therapies that will ultimately have a significant clinical impact.

After earning his Ph.D., Melchiorri would like to start his own biotech company. He was inspired to pursue entrepreneurship by

◀ ANTHONY MELCHIORRI WITH DR. FISCHELL
PHOTO BY LUISA DIPIETRO

his experiences at another of his undergraduate internships, a bioinformatics startup company called Bio::Neos. He is also interested in teaching, and considers his time as a T.A. for a high school biomedical engineering class one of the most rewarding experiences he has had.

Outside of the lab, Melchiorri enjoys fiction writing, reading, skimboarding, scuba diving, and playing blues guitar. He has also been involved in a variety of volunteer and charitable activities while a member of Tau Beta Pi and the social fraternity Beta Theta Pi.

JORDAN MAKES RESEARCH AN INTEGRAL PART OF HER CURRICULUM

BioE senior **Kesshi Jordan** hasn't waited for graduate school or her first "real world" job to get research experience. In her time as an undergraduate, she hasn't just gotten her feet wet—she dove in. Her advice to current and future undergraduates is to do the same, not only to boost their resumes, but also to discover where their passions lie.

For the past three summers, Jordan has been part of the Army Research Laboratory's (ARL) Science Outreach for Army Research (SOAR) program, which invites students from many disciplines and all levels to collaborate on projects with ARL scientists. SOAR's goal is to create an environment in which students gain technical skills and leadership experience, and are given the freedom to explore creative approaches to real problems. Once assigned to a project team and under the guidance of an ARL mentor, they have the same duties as professional researchers, including the ones that take place outside of the lab, such as conducting literature searches and feasibility studies, writing proposals, and presenting results in technical reports.

Jordan had previously worked on biomimetic communications mechanisms for millimeter- to centimeter-scale robotics, and the design of flight stabilizers for micro air vehicles inspired by comparable biological systems found in flying insects.

In the summer of 2011, under the guidance of an ARL team of signal processing experts and neuroscientists, Jordan worked to create a filter capable of improving the signal generated by electroencephalography (EEG), a technology used to noninvasively record the brain's electrical activity.

"Our project [was] to design a filter that can be tuned to the signal of interest, separating it out from the noise so that EEG data can be viewed with a much higher signal-to-noise ratio in near-real-time," she explains.

If the signals can be improved, they could be used to enhance brain-machine interfaces that allow people to control robots and prosthetics in dynamic, non-laboratory environments. Jordan returned to the ARL over winter beak to continue her work on the project, and hopes to publish a paper about her results. Jordan credits her BioE coursework experience with MATLAB and one of her biological sciences electives, Neural Systems, with giving her the background and perspective she needed for the project.

During the school year, Jordan keeps her research skills sharp by taking advantage of the on-campus opportunities BioE and the Clark School provide. She is currently completing the research component of the Engineering Honors Program as a member of BioE assistant professor **Silvia Muro**'s research group, in which studies targeted drug delivery. She is also a member of Gemstone, the Clark School's living-learning community, in which students design and conduct research that explores the interdependence of science, technology and society. Jordan's Gemstone team has been studying the motion of infants at high risk for autism using motion-capture technology.

After graduation, Jordan plans to attend graduate school.

DANDIN WINS FIRST JIMMY H. C. LIN AWARD FOR ENTREPRENEURSHIP

BioE graduate student and Fischell Fellow **Marc Dandin**, his co-advisor Associate Professor **Pamela Abshire** (Department of Electrical and Computer Engineering [ECE]), and **David Sander** (Ph.D. '11, ECE) received the first Jimmy H. C. Lin Award for Entrepreneurship in September 2011 in recognition of their business plan for Ibis Microtech, one of the finalists in the 2011 University of Maryland $75K Business Plan Competition. The fledgling company aims to equip medical professionals, food quality control technicians, first responders, and national defense agencies with cost-effective diagnostic devices capable of performing laboratory-grade analyses on-site and in record time.

The award is one of several offered by the Jimmy Lin Endowment for Entrepreneurship. Established by Mrs. **Anchen Lin** in honor of her husband, the late ECE professor **Jimmy H. C. Lin**, the fund provides annual awards to students, staff, and faculty who transform their ideas into products through technology commercialization. The endowment's goal is stimulate, encourage and reward involvement in the invention and patenting process.

"I am very honored and humbled to share this award with my colleagues in ECE," says Dandin. "[We] would like to thank Mrs. Lin for continuing Dr. Lin's vision to inspire students and faculty to engage in technology entrepreneurship. I am also thankful to [my] department, BioE, for playing an active role in nurturing a strong entrepreneurship tradition within the [A. James] Clark School of Engineering through its Fischell Fellowship Program. Being a Fischell Fellow has greatly broadened my Ph.D. experience by allowing me to devote time to multi-disciplinary technology ventures such as Ibis Microtech."

▲ BIOE SENIOR **KESSHI JORDAN** HAS ALSO PUT HER ENGINEERING SKILLS TO USE AS A MEMBER OF ENGINEERS WITHOUT BORDERS, TRAVELING WITH THE UNIVERSITY OF MARYLAND CHAPTER ON AN IMPLEMENTATION TRIP TO COMPONE, PERU IN 2009. IN ADDITION TO INSTALLING A WATER SANITATION SYSTEM WITH HER TEAM, JORDAN RAN AN EDUCATIONAL PROGRAM FOR CHILDREN TO PROMOTE WATER SANITATION AND SAFETY. *PHOTO COURTESY OF KESSHI JORDAN.*

The 2011 Fischell Festival

A CELEBRATION OF BIOENGINEERING'S POTENTIAL TO IMPROVE LIFE FOR MILLIONS OF PEOPLE

On October 20, 2011, the Fischell Department of Bioengineering held its fifth Fischell Festival. After welcoming guests and officially announcing the department's role in the establishment of a U.S. Food and Drug Administration Center of Excellence in Regulatory Science and Innovation *(see related story, p. 1),* our keynote speaker, FDA Chief Scientist and Deputy Commissioner for Science and Public Health, **Jesse L. Goodman**, M.D., M.P.H., was on hand to discuss what the new partnership would mean for the approval processes applied to new drugs and biomedical devices.

GOODMAN: FDA'S CHALLENGES, PLANS FOR PARTNERSHIPS

Goodman's keynote address, "Advancing Regulatory Science: Opportunities to Transform Product Development and Evaluation," introduced guests to the FDA's new strategic plan for advancing regulatory science, and how building partnerships with academia and industry—like the establishment of the new CERSIs with UM and Georgetown University—will be critical to advancing its goals.

Addressing the criticisms leveled against the agency, Goodman explained how difficult its job can be. "The FDA regulates products that relate to 25% of the nation's economy," he told the audience, "so you can see how the potential to do good in terms of promoting innovation, to do harm if you unnecessarily slow it, or to do harm if you make decisions that allow unsafe products on the market, is tremendous."

Releasing a therapy that doesn't work well or for enough people but doesn't do any harm can be problematic, he said, because it wastes money and time that might otherwise be invested in something better. A successful clinical trial does not always lead to a product on the shelves, because it might encounter difficulties in manufacturing, transportation, and patient use.

The FDA's new strategic plan and vision, Goodman explained, is to speed innovation, improve decision making, and get safe and effective products to people in need by focusing on eight key areas: Modernizing toxicology by replacing animal testing with sophisticated human models, improving clinical trials through better prediction of long-term effects, improving manufacturing, preparedness for handling the evaluation of emerging technologies, compiling health data from multiple sources, food safety, addressing the threats of new and emerging diseases, and patient education.

"We have tremendous opportunities," Goodman concluded, "…but to really transform them into things that help people is going to require partnerships…We really welcome the University of Maryland and scientists present and future to join us in that."

PANEL 1: "BEYOND BIOE@UMD"

In the afternoon's first panel discussion, three alumni shared stories about the diverging career paths they have taken after completing their bioengineering education: **D.T. Howarth** (B.S. '09) is a third-year medical student at the University of Maryland School of Medicine; former Fischell Fellow **Dan Janiak** (Ph.D. '09, materials science and engineering) is an associate at the bio-oriented venture capital firm DFJ Mercury; and **Theresa Smith** (B.S. '01, biological resources engineering) is a Research Program Analyst in the Division of Musculoskeletal Diseases at the National Institutes of Health.

All of the alumni stressed the importance of getting involved in research and internships as early as possible to hone one's interests and stand out when applying to jobs or graduate schools, as well as networking with professors, doctors and professional societies. They also agreed that while they often couldn't wait to be done with group projects, good teamwork skills are essential for a successful career.

"You can't get rid of people after a semester," Smith pointed out, noting that workplace teams are far more diverse in terms of backgrounds and skills.

Good communications skills are also essential: Janiak needs to be able to explain concepts to non-technical people—a skill he says is often overlooked in engineering curricula—while Smith must be able to review and discuss grant applications and proposals from many different kinds of research groups. Howarth must not only communicate with patients, but also navigate the complex hierarchy of medical school and hospitals.

Asked for their best piece of advice for current students, Smith recommended reading *What Color Is Your Parachute?* to prepare for entering the job market.

"Take a fun class," said Howarth. "Network. Don't freak out. When you finish [a degree in] engineering, you can do anything."

PANEL 2: "BIOENGINEERING ENTREPRENEURSHIP"

Janiak stayed on for our second panel, in which he was joined by BioE graduate student **Irene Bacalocostantis**, whose startup company PolyVec Systems, which she co-founded with her advisor, Professor **Peter Kofinas**, won big at the 2011 UM $75K Business Plan Competition; **Craig W. Dye**, Director of the Maryland Technology Enterprise Institute's (Mtech) VentureAccelerator program; and **Michael Gutch**, Managing Director of MedImmune Ventures.

Dye, Gutch, and Janiak represented three stages of entrepreneurship and product development. Mtech, based in the A. James Clark School of Engineering, is designed to work with students, faculty and staff whose ideas are in the earliest stages of development, providing them with the guidance they need to conceptualize a company and its product, write proposals and business plans, and meet with investors. DFJ Mercury works with companies and products in the early development stage, often concentrating on higher-risk, emerging platform technologies such as drug targeting

◀ DR. FISCHELL (CENTER) WITH STUDENTS AT THE POSTER SESSION systems. Young companies that are more established might get the attention of MedImmune Ventures, which works with more validated technologies such as cell and gene therapies, making them less risky investments.

Bacalocostantis is an example of a member of the Clark School community who has taken advantage of the opportunities and mentoring Dye and Mtech provide to prepare new entrepreneurs for landing funding and working with companies like DFJ Mercury and MedImmune Ventures. Her goal is to transition her creation of a targeted drug delivery system for the treatment of breast cancer into a marketable business.

Panelists offered advice for aspiring entrepreneurs. “Relationships are weighted very heavily,” said Janiak, adding that while the process of finding and receiving venture capital “is not mythical,” it does require a lot of networking in the community.


JENNY REGAN

“Get your story tight—it’s how you’re differentiated,” said Gutch. “You need someone with management or advisory experience on your team.”

Bacalocostantis and Dye said that taking advantage of mentoring resources and entering business plan competitions were great ways for new entrepreneurs to get their feet wet.

“Do your homework,” said Dye. “[The field of] venture capital is highly specialized. Start by asking for advice, not money.”

Asked what biotechnologies or markets they felt would see the most growth in the next ten years, the panelists suggested areas including the treatment of neurodegenerative, cardiac and obesity-related diseases, technologies for the aging population, and companion diagnostics used to streamline clinical trials.

REGAN: BIOMEDICAL DEVICE DESIGN FOR HOME HEALTH CARE

The Fischell Festival concluded with a Whiting-Turner Business and Entrepreneurial lecture delivered by **Jenny Regan**, co-founder and CEO of Key Tech, a Baltimore-based prototyping and development firm specializing in medical devices and precision instruments.

Regan kicked off her presentation, titled “Homeward Bound: Medical Devices as Home Appliances,” with a question: “If you can’t make a therapy that a patient can take effectively, then what good is the therapy?”

Patient-administered drugs and health monitoring are gaining in popularity due to the rapid advancement of biotechnology, consumer electronics, wireless networking, nanotechnology, and microfluidics. More and more portable devices are capable of serving patients in ways that used to require visits to the doctor’s office. This form of personalized medicine greatly reduces the cost of the treatment of chronic conditions, but comes with its own challenges.

Speaking from her experience designing home healthcare devices, Regan explained that Key Tech’s largest demographic—patients over 65—are also the least likely to feel comfortable using new technology. A diagnostic device for this audience must be able to do as much as possible, consistently and repeatedly, in as simple a way for the patient as possible. User interfaces might need to take issues such as declining vision or hearing into account. Repeated prototyping, Regan said, is essential.

Designers, she continued, must always put the patient first, and realize that it’s about what they need, not what designers want to create. “Don’t get caught up in a gee-whiz technology dream,” she said, adding that “it takes guts” to walk away from amazing technology that one actually doesn’t need to produce a successful product.

In addition to the challenges of designing for the patient, inventors must also be able to navigate regulatory requirements and working on a long-term project while technology continues to advance around them.

Key Tech’s other strategies for effective product design include creativity in design, software, and science; identifying and overcoming high-risk factors early in the design process; being able to admit failure; accepting criticism; and having an excellent interdisciplinary team of on- and off-site partners.

BIOTECHNOLOGY CAREER FAIR AND INFORMATION EXPO

Fourteen companies and organizations were on hand to demonstrate products and discuss services, education and careers in bioengineering, biomedical engineering, and biotechnology with interested students, faculty and guests:

- 5AM SOLUTIONS
- AEROTEK
- AMERICAN INSTITUTE FOR MEDICAL & BIOLOGICAL ENGINEERING
- BD
- CENTER FOR BIOMEDICAL ENGINEERING AND TECHNOLOGY (BIOMET), UMB
- FDA: CENTER FOR DEVICES AND RADIOLOGICAL HEALTH
- KEY TECH
- LOGOS TECHNOLOGIES
- NATIONAL INSTITUTE OF BIOMEDICAL IMAGING AND BIOENGINEERING
- QIAGEN
- SOCIETY FOR BIOLOGICAL ENGINEERS
- SOBE, THE UNIVERSITY OF MARYLAND, COLLEGE PARK STUDENT CHAPTER OF THE BIOMEDICAL ENGINEERING SOCIETY
- UMD OFFICE OF ADVANCED ENGINEERING EDUCATION
- UNION MEMORIAL HOSPITAL

The Fischell Department of Bioengineering would like to thank the Clark School’s office of Engineering Co-op and Career Services for organizing the career fair and information expo, as well as all of the companies and organizations that participated.

◀ LEFT: THERESA SMITH (B.S. ’01). RIGHT: D.T. HOWARTH (B.S. ’09).

PHOTO OF JENNEY REGAN BY AL SANTOS. OTHER PHOTOS BY BY LUISA DIPIETRO

A. JAMES CLARK
SCHOOL OF ENGINEERING
The Fischell Department of Bioengineering
2330 Jeong H. Kim Engineering Building
University of Maryland
College Park, MD 20742-2835

ABOUT THE COVER IMAGE

DURING THE IMMUNE RESPONSE, NEUTROPHILS TRANSMIGRATE THROUGH THE ENDOTHELIUM, THE LAYER OF CELLS THAT LINE THE BLOOD VESSEL, IN ORDER TO EXIT THE BLOODSTREAM. THE PURPLE IMAGE USED ON THE COVERS, FROM PROFESSOR **HELIM ARANDA-ESPINOZA** AND **KIMBERLY STROKA** (PH.D. '11), SHOWS SOME OF THE BIOPHYSICAL MACHINERY IN AN INTACT, HEALTHY ENDOTHELIUM, INCLUDING THE F-ACTIN CYTOSKELETON (THIN, WEB-LIKE STRUCTURES), VINCULIN PUNCTATES AS MARKERS OF FOCAL ADHESIONS (PALE AREAS), AND THE NUCLEI (OVALS). NEUTROPHILS DISRUPT THESE STRUCTURES IN ORDER TO PENETRATE THROUGH THE ENDOTHELIUM AND COMPLETE TRANSMIGRATION. TO LEARN MORE, SEE P. 5.

BIOFEEDBACK is published for alumni and friends of The Fischell Department of Bioengineering at the A. James Clark School of Engineering, University of Maryland.

Alumni news and comments are welcome! Please contact us at:
Fischell Department of Bioengineering
2330 Jeong. H. Kim Engineering Bldg.
College Park, MD 20742
(301) 405-7426 / bioe@umd.edu
http://www.bioe.umd.edu

Department Chair: Dr. William Bentley
Editor: Faye Levine

Canon, U. Maryland Launch New Collaboration

Canon U.S. Life Sciences, Inc. (CULS), a subsidiary of Canon U.S.A., Inc., and the University of Maryland have launched a new research collaboration to develop a highly automated system providing rapid infectious disease diagnosis. The project aims to expedite the delivery of test results while also simplifying the process to allow a variety of clinical staff to perform the procedures.

The research team is led by Canon Senior Fellow **Hiroshi Inoue** *(see p. 7)* and Fischell Department of Bioengineering professor and chair **William E. Bentley**. Together with BioE professors **Keith Herold** and **Ian White**, they will develop a high-throughput system able to identify bacterial pathogens in human blood samples using genetic matching technology. At the core of the new device are CULS' proprietary genetic analysis system and a new microfluidic chip-based disposable testing cartridge. The project's ultimate goal is to provide doctors and clinics with sophisticated molecular analysis tools, enabling them to offer "bedside diagnostics" that cut the length of time required to test a sample from several days to one hour.

"Through our continued research in the area of molecular diagnostics, we are excited to be aligning our efforts with the University of Maryland," says CULS president **Takayoshi Hanagata**. "The combination of Canon U.S. Life Sciences core technologies and the University's leading-edge research capabilities will allow us to create new diagnostic applications designed to offer enhanced flexibility as well as reduced costs and biomedical waste."

"The establishment of this relationship represents a major industrial collaboration," says Bentley. "Leveraging our combined research capabilities is intended to advance the commercial portfolio of Canon U.S. Life Sciences while also assisting the university in its mission to create innovative knowledge and educational opportunities for its students."