

BIOMEDICAL ENGINEERING

HAJIM SCHOOL OF ENGINEERING AND APPLIED SCIENCES
& SCHOOL OF MEDICINE AND DENTISTRY

2011

biomedical
engineering



UNIVERSITY of
ROCHESTER



A MESSAGE FROM THE DEPARTMENT CHAIR

To the BME Family and Friends:

It has been another great year for biomedical engineering at Rochester. Our educational programs continue to develop at all levels. We graduated an outstanding class of 49 seniors last May with an almost equal number of men (25) and women (24)! Congratulations to Hannah Watkins and Kelli Summers, who were awarded Fulbright Fellowships; and to Ben Freedman, Adam Kozak, and Hannah Watkins, who won NSF Graduate Research Fellowships. Our BME teams dominated the Forbes design competition again this year, taking the top three spots. Special congratulations to Ben Freedman, who took it on himself to launch a peer-mentoring program for our undergraduates. The effort earned our BMES Student Chapter the National Mentoring Award at the annual meeting of BMES in October 2011. This is the third consecutive national award for the chapter, an unprecedented achievement. (If the UR BMES Chapter were a sports team, we would be talking dynasty!) Congratulations to all!

Our master's and doctoral programs are also thriving. We awarded 8 doctoral degrees and graduated 18 master's students this past year and currently have a total of 59 graduate students enrolled. This enrollment is impressive, considering 10 years ago we had no graduates, and fewer than 20 students enrolled. Congratulations to Javier Lapeira Soto, who won a Graduate Fellowship from the Department of Defense, and to Amy Van Hove, who won the Howard Hughes "Med into Grad" Fellowship from the Cardiovascular Research Institute. Our graduate program is poised for growth as we introduce a new master's program in medical device design. We are piloting the program this year and will be accepting applications for new students to start in summer 2012. This is an exciting program with a focus on practical engineering designs for the clinic. Students start with an eight-week immersion in different clinical settings, where they observe procedures and identify areas of need where new technology can make an impact. The year is spent taking classes and developing a design and prototype for an engineering solution. Thanks to Professor Ankur Chandra of BME and vascular surgery and Professor Amy Lerner from BME for organizing this innovative program and getting it off the ground.

Things are also moving forward in research. Special congratulations to Professors Amy Lerner, Laurel Carney, Jim McGrath, Regine Choe, Anne Luebke, Hani Awad, Kelly Madden, Seth Perry, and Danielle Benoit, all of whom were awarded new research grants this past year from NIH, NSF, and other sources. Collectively, our faculty is enjoying the highest level of funding in our brief history. These are remarkable achievements in view of the dark economic climate and funding challenges at the federal level. In our spare time, we also teach! Congratulations to Laurel Carney, who won the Engineering Professor of the Year award; to Scott Seidmann, who was voted the outstanding professor in BME; and to Diane Dalecki and Danielle Benoit, both of whom have won educational development grants to enhance their students' educational experiences. I am continually amazed, grateful, and proud of the outstanding efforts of our faculty in all that they do. Congratulations to all for your outstanding efforts on behalf of our students, the department, and the University.

Melioral

NEW VENTURES



BME Seniors Improving Automatic Detection of Epileptic Seizures

A group of BME seniors has been working together since fall of their sophomore year on a research project with the goal of improving automatic detection of epileptic seizures. This debilitating neurologic disorder has an impact on millions of patients, yet there is hope for better treatment through improved detection and, someday, prediction of seizures. The group founded UR DASDA (Database for Automatic Seizure Detection Algorithms) and established a goal of setting up an Internet-based database that will provide high-quality electroencephalographic (EEG) recordings for researchers around the world who are developing seizure detection algorithms. In collaboration with James Burchfiel, PhD, Michel Berg, MD, and staff in the Strong Epilepsy Center in the Department of Neurology, the students are collecting data that will be suitable for this research effort. Owen Zacharias, of BME and the Department of Neurobiology and Anatomy, has been coordinating efforts with the computing administrators at URM to establish a website that can handle the large data files that are being developed. The students designed a website that will allow researchers to carefully select and download examples of seizures for use in testing algorithms. They are currently populating the database with data files, with a goal of 100 entries, including infants through older adults and a wide range of seizure types. A preliminary report of this database will be presented at the fall conference of the Biomedical Engineering Society in Hartford, Conn.

Integrated Nanosystems Center Opens

by Peter Iglinski

On August 26, U.S. Representative Louise Slaughter joined Rochester President Joel Seligman; Rob Clark, Hajim School dean; and Nicholas Bigelow, physics and astronomy department chair, for the opening of the Integrated Nanosystems Center. The new center will bring together experts in physics, optics, chemistry, biomedicine, and bioengineering to expand the research and technology commercialization of fuel cells, biosensors, and other high-tech devices important to industry, medicine, national security, and the economy.

The center consists of a 1,000 square-foot metrology (measurement) facility and a 2,000 square-foot cleanroom fabrication facility. The cleanroom lab was designed and equipped in a way that ensures it is virtually free of dust, foreign particles, and chemical vapors. Congresswoman Slaughter secured a total of \$4.4 million in federal money across three funding cycles to make the project possible.



Departments of Biomedical Engineering and Surgery Announce New Master's Program in Medical Technology Innovation

The Department of Biomedical Engineering together with the Department of Surgery are pleased to announce the commencement of a new, collaborative master's program in medical technology innovation, with an initial focus in cardiovascular device design. This program intends to generate a new paradigm of device development in an era of increasing health care cost constraints and limited commercial resources. The graduates and associated intellectual property of this program will directly improve patient care through increased efficiency of clinician-engineer communications, more targeted and effective devices, and shifting device R&D to need-based development.

The biomedical engineering department will accept master's degree applications during the winter of 2011 for prospective students to begin the program July 1, 2012. All interested students must have or be completing a BS degree in biomedical engineering. More information is available at the program's website (www.urmc.rochester.edu/bme/graduate/).

The program is also interested in developing partnerships with device companies for collaborative work; please contact Ankur Chandra, MD, for details.



James McGrath

Coulter Foundation Grant

Professors James McGrath, PhD, (biomedical engineering) and Jeremy Taylor, MD, (nephrology) were recently awarded a Coulter Foundation grant to develop a wearable hemodialysis system using a breakthrough silicon nanomembrane technology originally developed at the University of Rochester. Taking advantage of the extraordinary permeability and selectivity of the nanomembranes, the team hopes to eventually replace clinic-based hemodialysis with a much smaller continuous dialysis system that allows patients to remain mobile. As clinical dialysis requires hours of immobilization during dialysis and fluctuations in toxin levels that cause side effects, a continuous wearable system would provide dramatic improvement in patient lifestyle.



Regine Choe

NIH Pathway to Independence Award

BME assistant professor Regine Choe, PhD, has received a three-year NIH Pathway to Independence Award (\$700,000) to investigate an alternative method to positron emission tomography (PET) scans to assess the effectiveness of chemotherapy for breast cancer. Because PET scans are relatively expensive, and since the contrast agent, Fluorodeoxyglucose (18F-FDG), contains radioactive compounds, frequent assessment of breast cancer tumors over the course of chemotherapy treatment makes PET scans a less than optimal choice.

The Choe lab will be using a new fluorescent dye to investigate if it can be used as a surrogate marker for glucose metabolism. In addition, the lab will investigate whether simultaneous monitoring of glucose and oxygen metabolism accessible by diffuse optical methods (with and without injection) can enhance the assessment of treatment efficacy. "We hope to find a less expensive, safer modality to measure metabolic changes in tumors induced by chemotherapy. The ultimate goal is to be able to determine if the chemotherapy is effective before the course of treatment is over, thus making it possible to change or discontinue the course of treatment if necessary," says Choe.



Danielle Benoit

Leukemia Research Foundation Grant

Biomedical engineering assistant professor Danielle Benoit, PhD, has been awarded a \$100,000 grant from the Leukemia Research Foundation (LRF). Benoit's Therapeutic Biomaterials Lab conducts research on developing new treatments for childhood leukemia by using synthetic hydrogels and polymers formed using reversible-addition fragmentation chain transfer polymerization (RAFT). In 1946, the Leukemia Research Foundation was established in Chicago to memorialize 12-year-old Sherwin Pessin. Since that time nearly 65 years ago, LRF has raised more than \$48 million to fund research, aid patients financially, and offer educational and emotional support programs.



BME Senior Design Team Recognized

For their senior design project, BME students Frances Bell '11, Jacy Krystal Balaon '11, and Swapna Kumar '11 worked on creating safer back braces for patients recovering from back surgery. The project, DonDoff, tied for second place in the Charles and Janet Forbes Entrepreneurial Competition at the University, won third place in the New York State Business Plan Competition, and was a finalist in the 2011 RESNA Student Design Competition, held in Toronto, Canada. The team was supervised by Amy Lerner and worked with Joanne Wu, MD, an alumna of the BME program, who is now a physician with the Unity Health System in Rochester, and Shawn Biehler, an alumnus of ME who now works at Rochester Orthopedic Laboratories.

BME students Frances Bell '11, Jacy Krystal Balaon '11, and Swapna Kumar '11 designed an award-winning senior project.



Alumna Katie Bush (left) catches up with Professor Danielle Benoit (right) during her recent visit to the department.

Jarrold Orszulak at MIT's AgeLab

Jarrold Orszulak (BS, BME '07, MS, ECE '08), credits his preparation at the University of Rochester for developing solutions in his current position. Jarrold Orszulak knows what it's like to be old. But not from personal experience. Through his job at MIT's AgeLab, Orszulak helps create the physical and mental experiences of aging and then develops scenarios to test new products to keep the aging population as independent and safe as possible. Since some of the evaluations use heart rate, skin conductance, and eye tracking to understand how individuals interact with these new products, Orszulak credits his BME work in physiology for helping him apply that knowledge to better product design. Orszulak is also part of a MIT's AgeLab research group working with NTT, Japan's largest phone company, to develop eHome, a system that can help adult children check up on their aging parents through a type of instant messaging over the computer. From the computer monitor, kids can virtually remind their parents to take their medications. Another BME alumnus, Alexander Lee (BME '10), also worked at the MIT AgeLab in the summer of 2010.

Alumna Katie Bush Visits Rochester and Discusses What It's Like to Work for a Start-Up Company

In February, former BME student Katie Bush (BS '03) visited Rochester to talk about her journey since graduating with a degree in BME with a concentration in chemical engineering. Katie completed her doctorate in February 2009 in biomedical engineering and medical physics from Worcester Polytechnic Institute and the Graduate School of Biomedical Sciences at the University of Massachusetts Medical School in Worcester, Mass. Her thesis project at Worcester Polytechnic Institute, "Designing Microfabricated Basal Lamina Analogs to Enhance Skin Regeneration," focused on developing a novel artificial skin substitute with enhanced tissue functionality by recapitulating features found in native skin into a collagenous biomaterial.

Currently, Katie is a scientist at Connective Orthopaedics in Woburn, Mass., leading biomaterial product development efforts in the advancement of soft tissue repair in the field of sports medicine. Her talk included a comprehensive review of her research and development activities there, as well as the rewards and difficulties of

working as a biomedical engineer for an early stage medical device company that is in the process of transitioning a platform technology from an academic environment to the clinic.

New York Times Features Paper Published by Dr. Aasim Padela

The *New York Times* recently featured the research of BME alumnus Aasim Padela, MD. In his recently published article in the *Journal of Medical Ethics*, Padela describes the dilemmas involved in caring for American-Muslim patients and provides some culturally sensitive, clinically possible solutions. Currently, Padela is an emergency medicine physician and Robert Wood Johnson Clinical Scholar at the University of Michigan. His research interests span transcultural bioethics and cultural accommodation and health care disparities. He holds bachelor degrees in biomedical engineering and classical Arabic and literature from the University of Rochester, attended medical school at Weill Cornell, and completed his emergency medicine residency at the University of Rochester.

STUDENT NEWS

BME Students Selected as Fulbright Scholars

BME undergraduate Hannah Watkins has been selected as a Fulbright Scholar in the United Kingdom. She will perform research next year with Molly Stevens, PhD, at Imperial College in London developing novel responsive drug delivery liposomes for cancer treatment.

BME undergraduate Kelli Summers has been selected as a Fulbright Scholar to conduct research on implementing a strategy to combat child pneumonia fatalities in Ghanaian rural hospitals. Kelli left for Malawi at the end of May to learn about conducting anthropological research and then traveled to St. Francis Xavier Hospital in Assin Foso, Ghana, to collaborate with a physician she met during a volunteer experience in 2009. She hopes to create modifications to the World Health Organization's Child Lung Health Program (CLHP) through the use of a focus group and then implement it in the children's ward to ultimately decrease the child mortality rate at St. Francis and provide a model for other hospitals in the area.

BME Students Awarded Fellowships for Graduate Research by the National Science Foundation

Three BME seniors received prestigious National Science Foundation Research Fellowships, and Michael Hoffman, a PhD student in the Benoit Lab, received an NSF Honorable Mention. The fellowship, which is part of a federally sponsored program, provides up to three years of graduate study support for students pursuing doctoral or research-based master's degrees.

The fellowship includes a three-year annual stipend of \$30,000, a \$10,500 educational allowance to the institution, and international research opportunities. Danielle Benoit, assistant professor in biomedical and chemical engineering at Rochester, says that the financial support provides students the flexibility to attend conferences, participate in training programs, and travel to meet with other researchers in their field.

The following graduating BME seniors received fellowships:

Benjamin Freedman '11
University of Pennsylvania

Adam Kozak '11
Duke University

Hannah Watkins '11
Cornell University

Students Recognized at the Undergraduate Research Symposium

Undergraduate students from BME research laboratories participated in the prestigious annual University of Rochester Undergraduate Research Exposition 2011 symposium. BME undergraduates Benjamin Freedman '11 and Kelli Summers '11 were both invited to speak at the Engineering and Applied Sciences Symposium Talks. Freedman discussed his work, "What is Q-Angle really measuring? A novel alternative to predict patellar maltracking," which received the Dean's Award. Summers spoke about her research with Professor James McGrath, "Mechanisms Underlying Collective Cell Migration in Vitro," which was recognized by President Seligman with the President's Award. In addition, five of the seven poster exhibitions from the Hajim School of Engineering and Applied Sciences were by BME students:

Molly Boutin (Benoit Lab) BME '11

A Polymeric Delivery System to Induce Differentiation in hMSCs

Jasmine Carvalho (Dalecki Lab) BME '11

Investigations of Ultrasound Parameters to Promote Spatial Organization of Cells in Three-Dimensional Engineered Tissues

Vlabhav Kakkad (McAleavey Lab) BME '12

Experimental Implementation of Shear Wave Induced Phase Encoding Imaging

Angela Ketterer (Carney Lab) BME '12

Design and Implementation of a Behavioral Apparatus for Auditory Research in Birds

Hannah Watkins (Benoit Lab) BME '11

Novel Parthenolide Delivery System for Acute Myeloid Leukemia Treatment
(Received the Professor's Choice Award)

FACULTY AWARDS

Anne Luebke Research Group Receives Provost's Multidisciplinary Research Award

Anne Luebke, PhD, was part of a research group that conducted a study at the University of Rochester, "Perception of Music and Language through Auditory Interference," which was selected as the recipient of a 2011 Provost's Multidisciplinary Research Award.

The work is based on the ability to filter interfering auditory signals from a primary stream as a basic aspect of social and musical communication. Musical performance requires continuous attention to a complex auditory signal: how does this expertise interface with the processing of linguistic signals? Is auditory filtering ability facilitated by musical training? In order to explore these questions, the study brings together the following researchers:

- **Musical Pitch Perception:** Elizabeth Marvin, PhD—Eastman School of Music
- **Linguistic Phonological and Phonetic Analysis:** Joyce McDonough—Linguistics
- **Auditory Processing:** Anne Luebke, PhD—Biomedical Engineering and Neurobiology and Anatomy



At the annual University of Rochester Undergraduate Research Exposition, Professor Laurel Carney (left) received the Engineering Professor of the Year award. BME undergrads Kelli Summers (middle) and Benjamin Freedman (right), were also recognized for their research during the symposium.

Laurel Carney Awarded Engineering Professor of the Year

At this year's prestigious annual University of Rochester Undergraduate Research Symposium, BME professor Laurel Carney, PhD, was recognized by the Student Association as the Engineering Professor of the Year. Undergraduate Travis Bevington, BME '12 said, in presenting the award, "Even with all of her research, Professor Carney manages to find time to spend countless hours with students on projects, and it really proves how much she cares about our success as students. She really serves as an outlet to different opportunities that students might be unaware of, such as finding a lab position or research opportunity. Beyond the classroom, Professor Carney is always in high demand for letters of recommendation—students really feel like she takes the time to get to know all of us."

Danielle Benoit Selected as a WHEEL Scholar

This past spring, BME professor Danielle Benoit, PhD, received a WHEEL (Women's Health and the Environment over the Entire Lifespan) Award. Professor Benoit is working on a grant entitled "Inhibition of Bone Formation by Lead: Rescue with a Targeted Polymer Therapeutic" and will be mentored by J. Edward Puzas, PhD, from the Center for Musculoskeletal Research, and Deborah Cory-Slechta, PhD, professor of environmental medicine. The Women's Health and the Environment over the Entire Lifespan (WHEEL) program is a K-12 training program funded by NICHD and NIEHS through the Building Interdisciplinary Research Careers in Women's Health (BIRCWH) program. The grant was received by the URM Obsterics and Gynecology Department last September. It funds four scholars and is aimed at helping them to launch independent research careers.



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