University of Minnesota
Department of Biomedical Engineering
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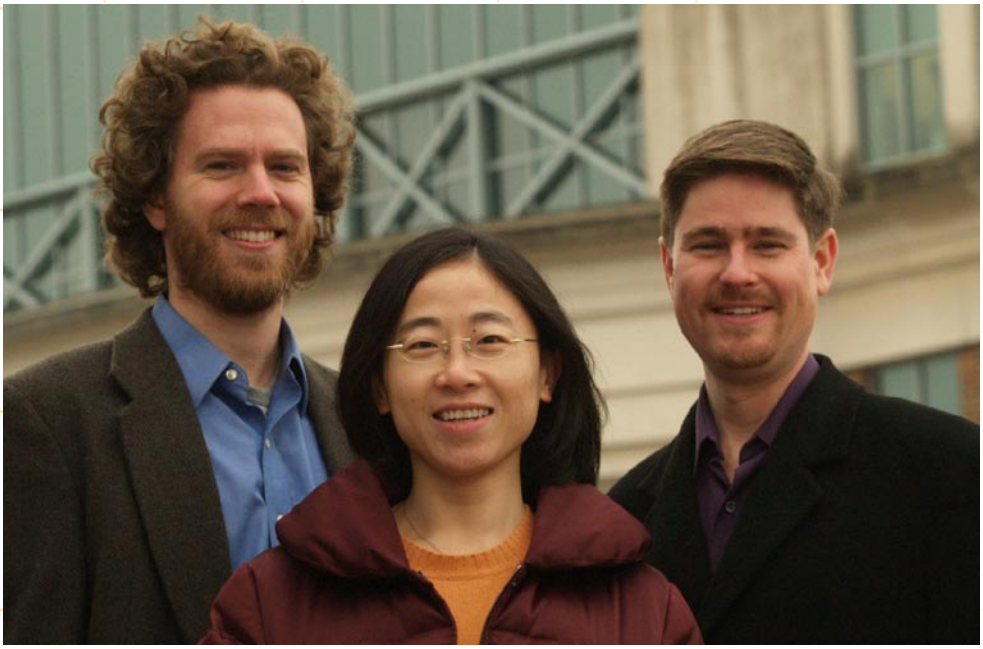
Department welcomes new faculty; grows 50 percent

The number of full-time faculty expanded from six to nine this academic year with the arrival of Professors **Theoden (Tay) Netoff**, **Jonathan Sachs** and **Wei Shen**. The new professors will substantially enhance the department's research programs and course offerings. The expansion is a promising trend for the future as the department grows its faculty size in concert with expanding enrollments.



New BME faculty members Professors Jonathan Sachs, Wei Shen and Theoden (Tay) Netoff.

Professor Tay Netoff completed a five-year postdoc at Boston University in the Department of Biomedical Engineering under the advising of Professor John White and support from an NIH NRSA Postdoctoral Fellowship. He earned his Ph.D. in neuroscience from George Washington University working with Professor Steven Schiff and supported by an NIH NRSA Predoctoral Fellowship. For his dissertation research, Netoff investigated the origin of non-linear neural network dynamics using patch clamp recordings of hippocampal slices in vitro along with computational modeling. For his postdoctoral research, he developed dynamic patch clamping and simultaneous calcium imaging to further investigate these dynamics and extend his models, focusing on synchronization and its implications for epileptic seizures. He will continue this line of research at the University of Minnesota and will develop a new undergraduate core course in biomedical systems analysis and a new elective course in neural engineering.

Professor Jonathan Sachs completed a two-year NIH NRSA postdoc at Yale University in the Department of Biochemistry and Biophysics under the advising of Professor Donald Engelman. He earned his Ph.D. in biomedical engineering from Johns Hopkins University where he held a Whitaker Foundation Graduate Fellowship working with Professor Thomas Woolf. For his dissertation research, he developed molecular dynamics simulations of ion penetration into lipid bilayers. For his postdoctoral research, he conducted Small Angle X-Ray Scattering (SAXS) experiments to determine how membrane proteins affect membrane thickness. His future research interests include the study of macromolecular interactions with biomembranes during drug delivery. Initially, Sachs is teaching the existing core course Cell and Molecular Biology for Biomedical Engineers and will develop a new undergraduate core course, Biomedical Thermodyamics.

Professor Wei Shen completed her Ph.D. in Chemical Engineering at CalTech under the advising of Professors David Tirrell and Julia Kornfield. Her doctoral work focused on designing, synthesizing and characterizing self-as-

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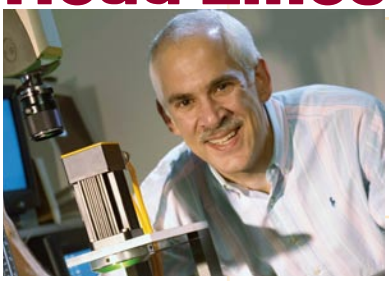
Head Lines



Since the inception of the department in 2000, much has transpired, including the launch of a new Bachelor of Biomedical Engineering degree program. It is already accredited by ABET, has graduated 162 students to date, and is expected to graduate 62 more this year. Our faculty has grown from three to nine, including three assistant professors highlighted above. An ongoing faculty search will help us to achieve double-digit status. With the three new additions, our department's research portfolio now includes neural and cardiovascular engineering, cell and tissue engineering, biomedical optics and imaging, biomembrane physics, and molecular biomaterials for tissue engineering and delivery of biologics. This research is fueled by an increasing number of graduate students and postdoctoral fellows, with major first-year graduate student funding recently gifted from local medical device companies (see News Lines inside). We are still on the growth curve and look forward to drawing more talented students to our degree programs, students who will go on to lead the next generation of biomedical engineers in academia and industry, as featured inside.

— Robert Tranquillo

Making a difference through Engineering World Health

By Santhi Elayaperumal

STUDENT SPOTLIGHT

Throughout my college career, I constantly searched for opportunities to learn about global health care. I wanted to know what it was like to work in the developing world, where I believed my help was needed the most. As a result, I got involved with Engineering World Health (EWH), a non-profit organization that brings medical technology to the developing world. I learned that university chapters across the country were repairing medical equipment to send to the developing world and that EWH sponsored design projects for simplified cost-effective alternatives to complex biomedical tools such as X-ray testers and blood-gas analyzers.

Elayaperumal repairing a hospital x-ray machine in Rivas, Nicaragua

I contacted Dr. Robert Malkin of Duke University, the Director of EWH, and I started an EWH chapter at the University of Minnesota. After a few stops at the Student Activities Office and meetings with interested students, our chapter was founded. The chapter gained momentum as we designed brochures, wrote letters, set up a Web site and started reaching out to institutions in the Twin Cities for donations. We teamed up with members of the University's Institute of Electrical and Electronic Engineers (IEEE) chapter on a project to design a low-cost centrifuge tester. Although we received many pieces of donated equipment, we still needed the skills required to troubleshoot the devices.

The following summer, I participated in the Duke-EWH Summer Institute and developed the essential troubleshooting skills that we needed for our chapter. Training was conducted in Costa Rica and included courses in Spanish and medical instrumentation. The instrumentation course highlighted major types of medical equipment found in hospitals in the developing world and taught their principles of operation, typical applications, and common problems. We also discussed how biomedical engineers can help alleviate obstacles in order to improve world health. I spent the second half of the summer at a hospital in Nicaragua helping to repair dysfunctional equipment and assess the technical needs of the hospital.

After learning that organizations donating medical equipment can actually cause more problems than help for institutions in the developing world, I felt an obligation to send only worthwhile equipment from our chapter. So if any equipment we collected required disposable parts, we found the necessary accessories to send with the machine. This was to meant to save the receiving hospitals time, frustration and storage space.

As president of the EWH Minnesota Chapter, I have been able to give other engineering students the opportunity to work with medical equipment and practice troubleshooting skills that will be helpful in their futures. I am pleased to know that several University of Minnesota engineering students are interested in participating in the Duke-EWH Summer Institute in the future, and I hope that more biomedical engineering students continue to take advantage of this unique opportunity.

For more information about the chapter, please visit www.tc.umn.edu/~ewh. For the complete article written by Elayaperumal, please see www.bme.umn.edu/newsletters.html

NEWS LINES

Wang Receives NSF CAREER Award

Professor Chun Wang was selected for the prestigious Faculty Early Career Development (CAREER) Program by the National Science Foundation based on his research proposal "Biomimetic Engineering of Responsive Biomaterials." The award supports the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization.

Tranquillo Named Biomedical Engineering Society Fellow

Professor Robert Tranquillo has been named a BMES Fellow "for outstanding contributions to cardiovascular and neural tissue engineering, understanding of cell-matrix interactions, and biomedical engineering education, and for dedicated national service to BMES."

He Appointed Conference Chair of IEEE-EMBC 2009

Professor Bin He has been appointed conference chair of the Annual International Conference of the Institute of Electrical and Electronic Engineers (IEEE) - Engineering in Medicine and Biology Society (EMBS), scheduled September 2009 in Minneapolis. It is a premier international conference in biomedical engineering and has had more than 2,000 participants.

Boston Scientific and Medtronic Endow BME Graduate Student Fellowships

Boston Scientific and Medtronic each gifted $500,000 to build an endowment, matched by University of Minnesota funds, to support new BME graduate students as Fellows for their first semester of study. Boston Scientific made the lead gift in a campaign aimed at local medical device companies, with the goal of an endowment that supports the entire class of BME graduate students each fall. It reflects the growing presence of Boston Scientific in Medical Alley and at the University. Medtronic is the largest independent medical device company in the world and historically employs the majority of graduates from the BME Graduate Program who join Medical Alley companies.

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ALUMNI ACHIEVEMENT

Kari Varichak – Boston Scientific

Kari Varichak graduated in the inaugural BME senior class of 2000 and has propelled herself to a position of technical leadership at one of the state's top medical device companies. Since the BME program was officially announced during the semester she graduated, Varichak's degree reveals the initiative she took in arranging a provisional curriculum within the department.

"Watching my grandmother go though bypass surgery and a valve replacement is what first got me interested in the field of biomedical engineering," Varichak said. "I attended the University of Minnesota with the hope that the university would begin offering an undergraduate BME degree program. At one point, I was told the degree program would not start by the time I graduated and that I would have to choose another engineering discipline, but thankfully, individuals like Professor David Odde [Director of Undergraduate Studies for BME] helped me develop a curriculum that allowed me to graduate with a BME degree," she said.

After graduation, Varichak took a full time position at Boston Scientific Corporation (BSC) in Maple Grove. She had worked there as a manufacturing engineering intern part-time while finishing her senior year at the University. "I knew it was the company I wanted to continue working for," she said.

Her first role at BSC was supporting the integration of a new renal and biliary stent system into manufacturing. She was responsible for production yields and process improvements after the product was commercially launched. After a year of supporting multiple stent delivery system product lines, Varichak was selected to help with the start-up of BSC's TAXUS Express2™ manufacturing area by overseeing the installation and qualification of several manufacturing lines and process validation activities. The TAXUS® drug-eluting coronary stent is

Kari Varichak, project manager, Boston Scientific Corporation

arguably the most successfully launched product in the history of the industry.

Varichak is currently the project manager for major operations initiatives, where she is already considered to be a technical leader of some of the most significant and complex initiatives associated with BSC's business.

Varichak's BME education from the University of Minnesota has proved to be invaluable. "The education I received at the University of Minnesota has helped me get where I am today in my career. The problem solving skills I learned in my engineering courses enabled me to tackle complex problems in manufacturing. Also, taking part in animal studies and design projects through the BME department allowed me to identify with many aspects of the medical device industry," she said.

Varichak is now pursuing an MBA degree, and has served as a mentor in the IT Mentor program. The department looks forward to many of its graduates serving in this program and eventually serving as BME senior design group advisers.

Please add your news to our alumni page at www.bme.umn.edu/alumni.html

News Lines *(continued)*

Barocas Receives GAANN Grant

Professor Victor Barocas was awarded a three-year grant from the Department of Education's Office of Post-secondary Education in the Graduate Assistantships in Areas of National Need (GAANN) program. This GAANN grant is for cardiovascular engineering and will primarily support new graduate students with this research interest.

Student Distinctions

Melissa Gardner, a BME doctoral student, won the "Paper of the Year" award from the editors of Molecular Biology of the Cell, the official journal of the American Society for Cell Biology. She presented her paper at the ASCB Annual Meeting in San Diego in December, which attracts about 7,000 attendees. Her paper described an integrated computer modeling and experimental investigation of how chromosomes move in a microtubule-dependent manner during cell division. Her doctoral adviser and co-author is Professor David Odde.

Zhongming Liu, also a BME doctoral student, was selected as a finalist in the highly competitive Student Paper Competition of the 28th Annual International Conference of IEEE-EMBS held in New York City in September 2006. His doctoral adviser and co-author is Professor Bin He.

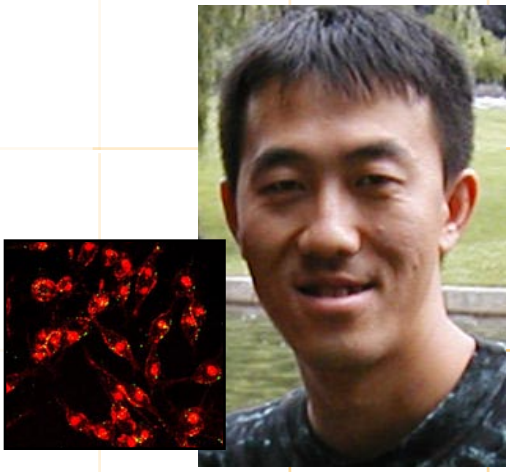
Archived news can be found at www.bme.umn.edu/news.html.

New faculty welcome cont.

sembled artificial protein hydrogels, which can serve as cell scaffolds. She then completed two years of postdoctoral studies at Caltech with Professor Scott Fraser in Biology, developing biosensors for monitoring protein activities in live cells and researching the effect of shear stress on vascular remodeling during mammalian embryo development. Professor Shen's research at the University will revolve around the design and synthesis of novel biomaterials and biomolecules that can be used to guide cell behavior and probe cell-material interactions. Initially, Shen will be teaching the existing elective course Tissue Engineering and developing a new graduate course, Polymeric Biomaterials.

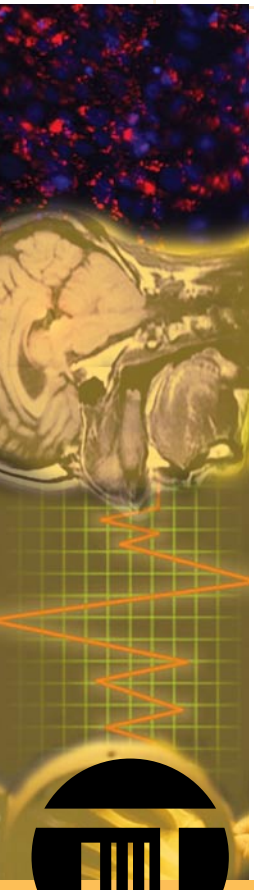
DRIVEN TO DISCOVER

Faculty Profile — Professor Chun Wang



Chun Wang is working to develop "smart" polymer nanoparticles (yellowish green dots on inset) to target immune cells (red) to deliver drugs and genes that may help treat cancer and infectious diseases.

The virus is a professional DNA delivery vehicle, gaining entry across the cell membrane like a Trojan horse, escaping the endosome before its degradation, and delivering its deleterious DNA to the nucleus with almost perfect efficiency. Professor Chun Wang and his students are developing multi-functional polymer nanoparticles for targeted delivery of DNA to specific cells of the immune system (see Figure) so as to mimic the tricks of the virus in transferring genetic material into cells, but without being harmful to humans. To assemble the nanoparticles, block copolymers are made to carry positive charges and be degradable inside the cell endosome; they are loaded with DNA and decorated with protein molecules as cell targeting ligands. It is hoped that the nanoparticles will help carry DNA plasmid vaccines to defend against infectious diseases or bring chemotherapy drugs to destroy cancer cells without damaging healthy tissues. Another area of interest for Professor Wang is the construction of biomaterial building blocks and scaffolds that harness and promote the intrinsic healing and regenerative power of adult stem cells. Stem cells rely on a specialized local environment, or "niche," in order to survive, differentiate, and repair damaged tissues. In many diseases and injuries, however, the proper stem cell niche is either altered or non-existent. Professor Wang's team is designing sophisticated biopolymeric materials, trying to recreate the natural "friendly" habitat for stem cells. By combining synthetic polymers with extracellular matrix proteins and polysaccharides, polymer hydrogels are being developed that provide necessary chemical and biological signals to sustain and regulate stem cell behavior. Such synthetic stem cell niches may eventually lead to more effective therapy of a wide range of diseases including heart disease.



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