University of Minnesota
Department of Biomedical Engineering
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University Leads Organization of EMBC'09

The 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'09) was held in Minneapolis, Minnesota from September 2-6, 2009. UMN BME faculty members made significant contributions in the organization of EMBC'09 and Bin He, the Department's newest Distinguished McKnight University Professor, served as the General Conference Chair.

The conference theme of EMBC 2009 was "Engineering the Future of Biomedicine," reflecting the conference vision for reviewing where the field is and where it should go for biomedical engineering research, and for discussing partnerships between academia and industry. The final scientific program comprised almost 1900 high quality contributed and invited presentations made by colleagues from around the world. Short papers were peer reviewed and accepted papers will be indexed in PubMed and MEDLINE. In addition, five pre-conference workshops were held which consisted of tutorials and state-of-the-art lectures in emerging areas in neuro-interfacing, deep brain stimulation, BioMEMS, cardiovascular health informatics, and medical technology commercialization.

The conference started on Thursday with a plenary address by Dr. Gary Glover, NAE, Stanford University professor of radiology, neurosciences and biophysics, followed by another plenary address by Dr. Earl Bakken, NAE, inventor of the battery-powered cardiac pacemaker and co-founder of Medtronic, Inc. at the welcome banquet. On Friday morning, the conference keynote address was delivered by the 2006 Nobel Prize in Medicine or Physiology, Dr. Andrew Z. Fire, NAS. On Saturday morning Dr. Doug Lauffenburger, NAE, Whitaker Professor and Director of Biological Engineering Department at MIT, delivered another plenary address. In addition to these plenary presentations, Drs. A. Alavi, R.L. Ehman, J.G. Fujimoto, P. Hunter, J.C. Principe, A. Schwartz, R. Tranquillo (UMN-BME), K. Ugurbil (UMN-Radiology), and L.V. Wang presented theme keynote lectures on topics related to biomedical imaging and optics, neuroengineering and neuroscience, physiome, and tissue engineering.

Earl Bakken, UMN alumnus, co-founder of Medtronic, speaking at EMBC'09.

"I want to tell you my version of pacing since I lived through so much of it at the University of Minnesota ... of which I am very proud."

—Earl Bakken, EMBC'09

A particular feature of the conference was the enhancement of collaboration between academia and industry, made possible by EMBC'09 being held in the heart of Minnesota's famed Medical Alley. On Thursday afternoon, industrial leaders from major medical device and healthcare

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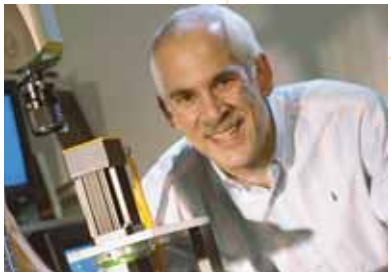
Head Lines



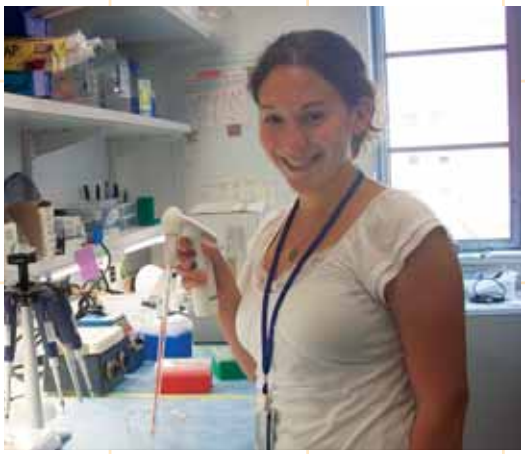
Bob Tranquillo, Distinguished McKnight University Professor and Head

Preparing to host EMBC'09 was a major focus of the department this year, and a huge success by all measures due to the tremendous leadership and tireless efforts of our colleague Prof. Bin He. In addition to providing an outstanding program for the participants, EMBC'09 also elevated the visibility of our department across the U.S. and around the world. At print time, we are close to hiring our 13th faculty member, with another search just starting, so the faculty growth continues. Fortunately, the department is also expanding its research facilities, moving into the sixth floor of Hasselmo Hall this year, which will triple the size of our prime research space. Most of our research operations in Shepherd Laboratories will be moved into Hasselmo Hall while our instructional labs will be moved to larger teaching labs located in Moos Tower nearby in the Academic Health Center.

This is also fortunate because our academic programs continue to grow as well, with 67 seniors expected to graduate this year, up from 60 last year. Our graduate program is also growing, with 130 students now enrolled. As evidenced in the News Lines inside, our graduate students and postdocs, as well as our faculty members, continue to be recognized for their research achievements. We look forward to more talent joining our department this year!

student spotlight

Anna Budde



With about 15% of BME majors matriculating to medical school, we wanted to ask BME senior Anna Budde about her experiences in preparing for medical school. Anna is a member of Tau Beta Pi and has been awarded the Minnesota Gold Full Tuition, 3M, IT Merit, and Learning Abroad Scholarships.

Why did you choose BME for your major?
I initially chose BME because it sounded interesting, and I wanted a good backup in case I didn't get into medical school. I stuck with it because, beyond the basic math and physics, I enjoy studying the applications of engineering to the human body. I also like the idea of being able to help people by creating new medical devices. Now that I have been in the program for three years, I have decided to try to incorporate research in the BME field into my career as a physician.

How does the BME program fit with your medical school intentions?
While it was not always easy to squeeze in the pre-requisite classes for medical school while taking a full load of BME courses, once I was in upper division I found the BME program pretty accommodating, especially within the cell and tissue engineering emphasis area. I also think the BME program will be a great way to prepare for medical school. I've learned creative problem solving skills that will be very useful in my career as a physician.

What activities and experiences have you engaged in to prepare for medical school?
To prepare for medical school I've engaged in volunteer, shadowing, and lots of undergraduate research experiences. I've been volunteering at the University of Minnesota Medical Center for over 3 years, and I spent last summer shadowing physicians and volunteering at a hospital in Tanzania. I've also been working in a virology research lab associated with the U of M Medical School for the past three years and have performed a few different research projects there relating to Epstein-Barr Virus (the virus that causes Mono). Also, this summer I've been interning at NIH as part of the Biomedical Engineering Summer Internship Program (BESIP). So, I've been busy, but all of these activities have made important contributions to my motivation to become a doctor and to my preparation for medical school.

What was the most exciting aspect of your NIH summer research project?
At NIH I've been working on isolating cortical collecting duct cells from rat kidneys, a cell type that has never been successfully isolated by our lab. That means I spent most of my summer trying different things, most of which failed, before I finally came up with a method that works. The most exciting part of this project was that each time it failed I got to use some new technology to try to fix it. I ended up using fluorescence microscopy, flow sorting, PCR, and microarrays before the project finally succeeded, so I was exposed to lots of equipment that I would not have had the opportunity to use if the project had succeeded right away. It was exciting to have access to so many different resources and so many knowledgeable and helpful scientists.

What advice do you have for the BME students who will graduate after you?
I think the most important advice I have is to get involved in some sort of internship or research experience. Sometimes the classes seem so theoretical and broad and it's hard to imagine how the information you are learning will be applied. When you get to work on a project and apply the knowledge you learn in school it really helps you figure out where your interests truly lie. Also, take advantage of learning abroad opportunities if you can. My international experiences had nothing to do with BME but they were really fun and gave me an opportunity to study something outside of science for a change. My exposure to plenty of experiences outside engineering has made my college career much more well rounded and more enjoyable.

news lines

Faculty

Professor **Bin He** was named one of this year's four Distinguished McKnight University Professors.

Professor **David Odde** was selected for the Institute of Technology's George W. Taylor Award for Distinguished Research.

Students

Lauren Black, a post doctoral researcher advised by Prof. Tranquillo, will be appointed as a tenure-track assistant professor of Biomedical Engineering at Tufts University, starting August 2010.

BME graduate student **Melissa Gardner**, advised by Prof. Odde, was awarded the University's Best Dissertation Award in Physical Sciences and Engineering at UMN in 2009.

BME graduate students **Han Yuan** and **Qiang Xiong** were awarded University of Minnesota Doctoral Dissertation Fellowships. They are advised by Profs. He and Zhang, respectively.

BME graduate student **Krissy Thatcher** was awarded first place in the Ph.D. student poster competition at the 2008 Meeting of the Tissue Engineering and Regenerative Medicine International Society. She is advised by Prof. Tranquillo.

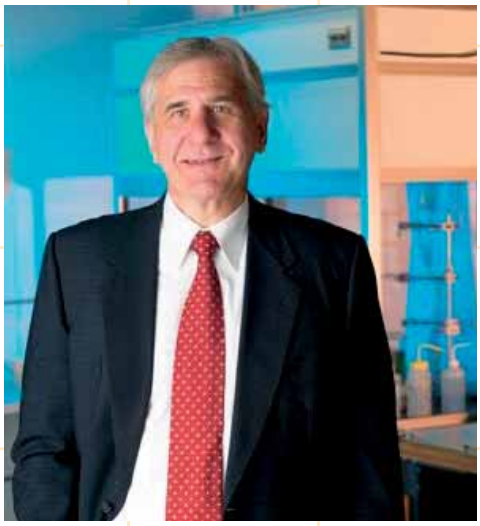
BME graduate student **Rouzbeh Amini** was awarded one of three first place awards in the Ph.D. student poster competition at the ASME Summer Bioengineering Conference. He is advised by Prof. Barocas.

BME senior **Rebecca Szarkowski** was awarded both a National Astronaut Foundation Scholarship and a Barry M. Goldwater Scholarship.

Graduating BME senior **Jenna Shaw** was selected as the 2009 IT Student Commencement Speaker.

alumni achievement

Michael J. Kallok, Ph.D.



Mike was among the very first students to receive a Ph.D. in BME from UMN, in 1978, advised by Dr. Ted Wilson. Following graduation he spent two years as a Research Fellow at the Mayo Clinic. He recently retired from Cardiovascular Systems, Inc. (CSI), where he served as CEO for 5 years and Chief Scientific Officer for 2 years. Prior to CSI Mike worked for Medtronic for 16 years where he received Medtronic's highest management award, the Wallin Leadership Award in 1991, and was elected to the Bakken Society in 1994. After leaving Medtronic in 1995, Mike worked at Angeion, Myocor, and Boston Scientific in a variety of positions including R&D, Clinical Affairs, Regulatory Affairs, and Executive Management, in a career spanning 30 years. Mike is an elected Fellow of the American College of Cardiology, the AHA, and AIMBE. He has authored over 100 published works relating to cardiac electrophysiology and defibrillation and holds 18 US patents.

What was the BME graduate program like back in its formative years?
There was very little structure. Each student met with his or her advisor to design a curriculum. I personally took a lot of physiology courses, biochemistry courses, and chemical engineering courses.

What is your favorite memory from those years?
Believe it or not, one of my favorite memories was taking my comprehensive oral exams with the Dean of the Medical School, the Chairman of the Physiology Department, a Biochemistry Professor and two "token" Engineering Professors (one of whom was my major advisor) as Committee members. Of course each Committee member expected you to know as much as graduate students in their respective departments did, so the questions were pretty difficult. My advisor had told me that he would only ask me questions if I was "on the fence" and needed some help in order to pass the oral exam. He said if I were doing really well or very badly he would not ask any questions. So when his turn for questions came, he excused me from the room without asking anything and I left not knowing if I had passed or failed miserably!

How did your PhD in BME influence your career path?
My undergraduate degree is in Aerospace Engineering. I became so intrigued by the possibility of using engineering to solve problems in biology and medicine that I applied to UMN to enroll in its BME Ph.D. Program (one of only a few such programs available then). Because of the types of courses I took, my career has focused on biology, medicine, and the clinical aspects of BME. So I went from designing jet engines to studying the heart and other major organ systems.

What kinds of interactions have you had with UMN during your career?
Eventually devices have to be evaluated clinically, and I have worked primarily with faculty from the Medical School to gain their input into various medical devices that I have helped design and develop. This spirit of cooperation by the faculty is one of the great benefits that UMN BME students can enjoy.

Do you foresee any major changes in the medical device industry in the next decade?
The recent discoveries in genetics and molecular biology have enormous potential to enable physicians to diagnose and cure disease, but the medical device industry will play an essential role in developing the equipment and devices required to make those diagnoses and deliver the therapies.

What advice do you have for BME students aspiring to careers in the medical device industry?
BME is a dynamic field of study and the medical device industry is constantly changing and evolving. My advice is to make learning a lifelong process, whether you take formal courses or do self-directed study. If you do nothing, your current knowledge will be obsolete in a short period of time.

EMBC '09, cont.

companies addressed the participants with regard to the trends, challenges, and opportunities in the medical device and healthcare industry. In addition, there were a number of special sessions covering a broad spectrum of biomedical engineering research and development, education, public policy, and translation to commercialization.

Beyond an outstanding scientific program, the conference had an excellent exhibitor program. Tours to major R&D centers including the University of Minnesota, Mayo Clinic, Medtronic, and Boston Scientific were also organized and well received by the participants.

"We are very excited that the international biomedical engineering community met in Minnesota this year, and are pleased that EMBC'09 had a significant representation from industrial colleagues and physicians. I am very grateful to all colleagues, volunteers, and sponsors whose contributions made EMBC'09 a huge success," said Dr. Bin He.

faculty profile

Professor Hubert Lim

The thought of implanting computer chips into the brain to restore sensation or movement at first seems like something from a science fiction movie. However, new neural technologies and computer algorithms are enabling significant advances in deep brain stimulation (DBS) that can treat debilitating diseases and injuries.

Professor Lim and his team are pushing the development of the next generation of auditory prostheses based on DBS. Through nine years of animal and human research in collaboration with several leading clinical, research, and industrial groups worldwide, Professor Lim and his colleagues have pushed the development and clinical translation of a new DBS system for restoring functional hearing in deaf patients (see Figure). In addition, Professor Lim hopes to use DBS to suppress tinnitus, the perception of sound that does not exist, which can lead to detrimental psychological and emotional effects in patients.

Professor Lim's group performs animal studies to better understand how the brain processes sound and how neural coding of sound can be regulated by brain centers, such as those involved with learning and plasticity. EEG and psychophysical studies to acoustic and electrical stimulation of the auditory system are also performed in humans and related to findings from animals to enhance the understanding of neural processing in the human brain. This research will lead to the development of improved deep brain stimulators and algorithms that can favorably stimulate the neural circuitry required for improving hearing and suppressing tinnitus in human patients.

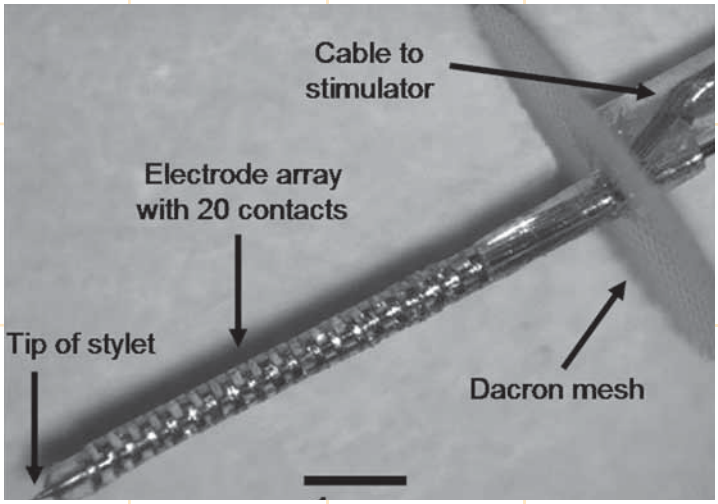
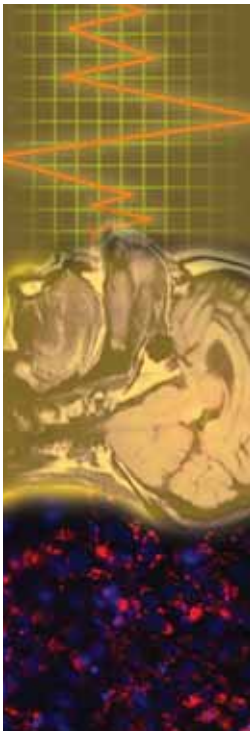


Image of the new DBS array (developed by Cochlear Ltd. - Australia) implanted into the auditory midbrain of deaf patients. The stylet is removed after the silicone array is inserted into the brain. The Dacron mesh stabilizes the array within the brain. The cable connects to a wireless interface implanted into the skull that receives stimulation sequences and power from an external processor.



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