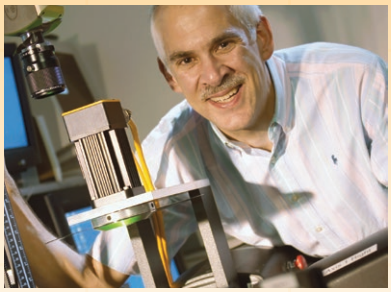
University of Minnesota
College of Science & Engineering
Department of Biomedical Engineering
Volume 1 • 2012–13

Head Lines:



Bob Tranquillo, Distinguished McKnight University Professor and Head

Two more faculty members just joined us: David Wood and Paolo Provenzano, so the department continues to grow in size – and another faculty search is underway. It is also growing in stature, as evidenced by the award of an NSF IGERT grant in Neural Engineering under the leadership of Bin He, which along with an ongoing NIH T32 grant in Neural Imaging, establishes our department, along with key cooperating departments at UMN, as a major force in neural engineering. Additional evidence of our growing stature is our three senior faculty members now serving as editors-in-chief for major journals: Victor Barcoas (*J Biomech*), Bin He (*IEEE Trans Biomed Eng*), and David Odde (*Cell Molec Bioeng*). With his recent appointment as the director of IEM, Bin will also be instrumental in harnessing the tremendous potential for biomedical engineering innovation that exists across the university and connecting it to the department's research mission. As always, we look forward to more talent joining our department this year and contributing to our mission!

Bin He Appointed Director of the Institute for Engineering in Medicine

The University of Minnesota has taken the initiative to enhance the Institute for Engineering in Medicine (IEM), which is an interdisciplinary research organization aimed at strengthening research between engineering and biomedicine at the University of Minnesota. The Institute is jointly governed by the Academic Health Center (consisting of the Medical School, College of Pharmacy, School of Dentistry, School of Nursing, School of Public Health, and College of Veterinary Medicine) and the College of Science & Engineering.

Bin He was recently named the new director of IEM. Professor He is a Distinguished McKnight University Professor appointed in the Department of Biomedical Engineering. He had previously served as associate director for research of IEM. He also serves as director of the Center for Neuroengineering, director of the NSF IGERT Neuroengineering Training Program, and director of the NIH Neuroimaging Training Program. Professor He has published over 180 peer-reviewed journal articles in areas of neuroengineering, functional biomedical imaging, cardiovascular engineering, and biomedical instrumentation. His pioneering work on neuroengineering and neuroimaging has been widely recognized in the scientific community and featured by the ABC News, Washington Post, Scientific American, and the Economist, among others. Professor He has served as President of EMBS and was recently appointed Editor-in-Chief for IEEE Transactions on Biomedical Engineering from 2013 – 2015.

Professor Bin He

"The University of Minnesota has world-renowned medical and engineering faculty members and has made very significant contributions to the fields that interface engineering and medicine. IEM will implement a system to stimulate multidisciplinary interaction and collaboration among scientists, engineering and biomedical researchers, and industry partners, leading to fundamental discoveries and technological innovations that eventually benefit the diagnosis, treatment, and prevention of diseases," said Professor He.

The Institute's research is focused on five research themes: Cardiovascular Engineering, Medical Devices, Medical and Biological Imaging, Molecular and Cellular Engineering, and Neuroengineering. The Medical Devices Center, Center for Neuroengineering, and Biopreservation Core Resource are among the research centers affiliated with the Institute. The Institute has more than 120 faculty members from across the university who are conducting cutting-edge research that interface biomedicine with engineering.

Continued inside

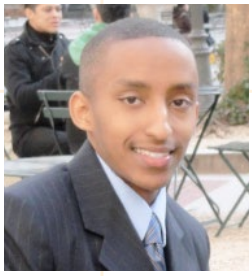
student spotlight

Study Abroad

The College of Science and Engineering has made a commitment to providing pathways for internationalizing the undergraduate experience, and we feature below several BME majors who have taken learning-abroad experiences.

Caroline Labat

I went to Karlsruhe, Germany for the summer after my sophomore year. I completed an eleven-week internship doing research at the Institute for Catalysis Research and Technology, a part of the Karlsruhe Institute for Technology. My research topic was hydrothermal carbonization, a process for turning biomass into a coal-like substance. I chose to go to Germany, because I have been learning German since high school, and Germany is famous for its engineers. This experience has taught me what it is like to work in a lab and do research. I have also learned how to work with a diverse group of people, since many of my colleagues were of different ages and from different countries.



Abrham Desta

Studying Management of Technology in the Middle East following my sophomore year this summer was an amazing experience and one that I believe will have a serious impact on my future. Surrounded by history at every turn, we explored the breath-taking cities of Tel-Aviv, Haifa, Jerusalem, Amman and Petra. Crossing borders into the West Bank and The Hashemite Kingdom of Jordan gave us a well-rounded perspective on many of the conflicts that the region is known for. Visits to cultural, religious, and historical sites also shaped a great deal of my time abroad. Seeing a different part of the world has had a major impact on how I view my own society, education and beliefs on what is truly important in life.

Elliott Surber

This past summer I was given the opportunity to reevaluate my own approach to the technical aspects of medicine. My journey began in Uganda with the UMN chapter of Engineers Without Borders. I worked beside a remarkable team of young engineers and after the project's completion, I decided to spend four months traveling Africa. In total I spent time in Ethiopia, Nigeria, Benin, Senegal, Mauritania, and Morocco. In each place that I visited, I looked at the most basic challenges of the given healthcare system. From an engineering standpoint, the cost of the diagnostics commonly exceeds that of the treatment. Without reliable, low-cost diagnostics, it becomes easier to misdiagnose ailments and render treatment for non-present disease while the true pathology may be overlooked. Biomedical engineers who develop such diagnostics can have great impact.

See this site for information about learning abroad:

http://cse.umn.edu/beyondclassroom/learnabroad/index.html

news lines

Faculty

Prof. **Bin He** was elected as Fellow of the International Academy of Medical and Biological Engineering.

Prof. **Victor Barocas** was selected for the College of Science & Engineering's George W. Taylor Award for Distinguished Research.

Prof. **John Bischof** was selected for the Van C. Mow Medal by the ASME Bioengineering Division.

Prof. **Wei Shen** received an NSF CAREER Award.

Profs. **Wei Shen** and **Taner Akkin** were promoted to Associate Professors with tenure.

Students

Emily Tubman, advised by Prof. Odde, was awarded a University of Minnesota Interdisciplinary Doctoral Fellowship.

Craig Markovitz, advised by Prof. Lim, was awarded a University of Minnesota Frieda Martha Kunze Fellowship.

Anthony Braun, advised by Prof. Sachs, was awarded an NIH NRSA pre-doctoral fellowship.

Graduating senior **Jeff Hyypio** received one of two First Prizes in the B.S. student competition at the ASME Summer Bioengineering Conference for research done with Prof. Barocas.

Marie Johnson, Ph.D.

Dr. Johnson is the CEO of AUM Cardiovascular, Inc., a Northfield Minnesota-based medical device start-up company dedicated to the eradication of unnecessary death due to coronary artery disease. She received her Ph.D. and M.S. degrees from UMN in Biomedical Engineering. Her doctoral research was centered on the use of advanced digital signal processing techniques in the computerization of stethoscope diagnosis, which led to the primary product of her company. Marie also serves as an Adjunct Associate Professor in the department assisting with the senior design course.

You were a mechanical engineer at General Motors before coming to UMN for graduate studies. Why did you change your focus?
I spent nearly twelve years in a variety of positions within GMC. I learned more about large project management and leadership during those years than any other time in my life. With that said, my husband and I moved to Minneapolis from Ohio so that he could attend Bethel Seminary. After much soul searching and practical review of the Minneapolis job market, I decided to pursue a graduate degree in BME, and after a couple of BME classes, I was hooked.

What is the story behind AUM Cardiovascular?
AUM Cardiovascular is a labor of love for me. The device it offers is a solution to sudden cardiac death due to coronary artery disease, to which I lost my first husband, Robert Guion, in 2002. I was working on my Ph.D., and prior to having IRB Human Subjects Protection approval to collect data in the echocardiography lab at the hospital, I used Rob as my normal subject. I took lots of data from him as I learned how to use an electronic stethoscope. Little did I know that 9 months later he would die suddenly from a massive heart attack. I knew it was no accident that I was working on this technology at the time. After that, I spent nearly two years data mining before I found the missing link.

After completing my Ph.D. I did three Postdoctoral fellowships, the final one at Stanford University as a Biodesign Fellow (2007) where the goal is to train scientists and medical doctors how to develop and translate medical needs into commercializable devices. (The biodesign method is now employed in the UMN BME senior design course.)

With the benefit of that training, I started AUM in 2009. For nearly two years I spent my personal money to get the company going. We are now capitalized at $3.3M, which will take us through clinical trials. We have three full time employees and a host of consultants that have supported product development, quality systems requirements, reimbursement strategy and regulatory strategy. I can highly recommend hiring student interns; they bring a lot of energy and work hard, long hours.

Any recommendations for our students?
While I was at Stanford, I noticed an entrepreneurial confidence from people a lot younger than me. It occurred to me that the stimulating environment and being surrounded by similar-thinking individuals led them to take chances in starting a business. They were willing to fail.

The UMN BME students are trained in the biodesign method and are surrounded by the finest medical device consultants in the world. The most successful early medical device entrepreneurs started in the Twin Cities, which still offers a culture that will support medical device start-ups.

Please work somewhere that makes you happy and excited to go to work every day. Don't settle for a job where you aren't challenged or appreciated for your talents. And finally, set your heart on something you see as desperately needing a solution. If you can find that level of passion, the late nights and hard work will not be a burden. We are all created to do something amazing in our lives.

Bin He, cont.

IEM has unique strengths in its highly collaborative faculty networks and strong ties to Minnesota's medical device industry. Drawing on strengths from both the Academic Health Center and the College of Science & Engineering, the highly interdisciplinary nature of IEM makes it exceptionally well positioned to provide engineering solutions for the grand challenges in biomedicine and healthcare.

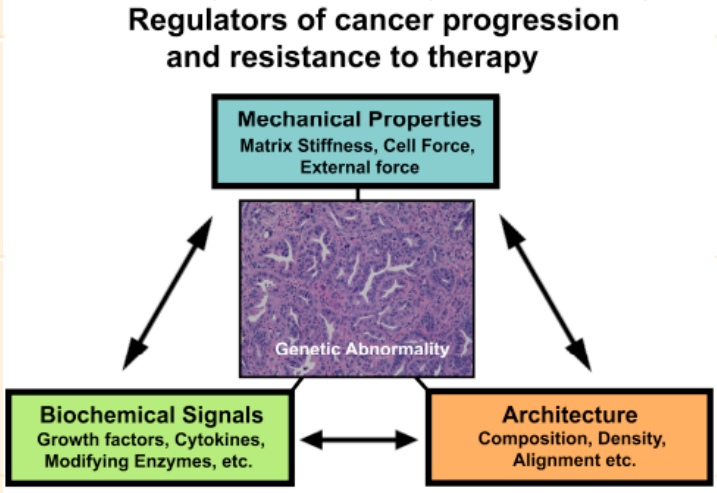
In the past years, IEM has funded several research projects in the Department of Biomedical Engineering leading to sponsored projects from NIH and other sources. The appointment of a departmental faculty member as the IEM director will enhance this productive collaboration between the BME department and IEM.

faculty profile

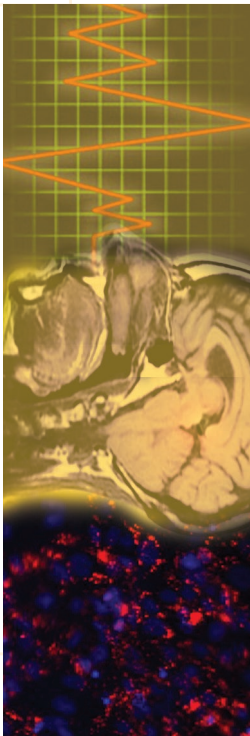
Professor Paolo Provenzano

Cancer takes the life of one person every minute in the United States despite significant progress in the battle against cancer. There is a clear need for novel strategies to better understand and treat cancer. Recent efforts have identified a complex relationship involving interplay between biochemical and physical factors. Although this knowledge has identified additional challenges to treatment, it has also provided a deeper understanding of cancer and new therapeutic targets to combat this disease. Rising interest from biomedical engineers to the cancer biology problem has opened the doors to a more quantitative understanding of cancer, rational design of drugs, and development of diagnostic and therapeutic technologies.

Professor Provenzano's laboratory is pushing the integration of engineering and biology in this new cancer initiative. Working to understand the interplay between chemical, structural, and mechanical elements in the tumor, they gain a novel understanding on the mechanisms of tumor progression as well as resistance to therapy. Focusing on the local environment surrounding cancer cells, Provenzano and colleagues have recently demonstrated that architectures in the tumor influence the spread of cancer and predict survival of breast cancer patients. Using cutting-edge techniques from cell biology, biomechanics, and optical imaging, they demonstrated that cancerous cells use biochemical signals to generate a pulling force that reorganizes their environment to facilitate spread of the disease. Similar structural and mechanical elements also conspire to severely impede the distribution of small molecule therapeutics in tumors. By specifically targeting elements in the cellular environment that are responsible for this resistance to therapy, they have established a novel strategy for delivering drugs to tumors. These and other advances are actively being translated from laboratory science to the clinic with the hope of improving patient outcome.



Factors that influence cancer progression and resistance to therapy are not only biochemical but also include the mechanical properties and organization of cells and their environment.



College of Science & Engineering
University of Minnesota

Department of Biomedical Engineering

Robert T. Tranquillo, Head
7-105 Hasselmo Hall
312 Church Street SE
Minneapolis, MN 55455
(612) 624-4507
www.umn.edu/bme

First Class Mail
U.S. Postage
PAID
Twin Cities, MN
Permit No. 90155