The Ten-Year Anniversary of the Department

What a difference 10 years makes!

2000: 0 BME majors; 60 BME graduate students; 3 FTE faculty

2010: 400 BME majors; 120 BME graduate students; 15 FTE faculty, plus an accredited B.S. BME program, a major initiative in neuroengineering, and critical mass in biomedical optics and imaging, cell and tissue engineering, and cardiovascular engineering.

This transformation, from a blank piece of paper to an established academic department, did not happen easily or rapidly, and reflects the dedication of the inaugural faculty members and key collegiate administrators. Among those are Profs. Victor Barocas, David Odde, and Bob Tranquillo, who have served as Director of Graduate Studies, Director of Undergraduate Studies, and Department Head, respectively, for most of the first 10 years. At the outset, Profs. John Bischof and Ron Siegel, who are appointed in Mechanical Engineering and Pharmaceutics, respectively, were invited as full faculty members in order to provide additional perspective in first launching and then growing a new department. Prof. Steven Crouch, now Dean of the College of Science & Engineering, played a key role in establishing the department as the Associate Dean for Finance and Planning in 2000, and the late Prof. H. Ted Davis was the Dean who decided the time was right to create a Department of Biomedical Engineering in 2000, still the newest department of the college.

The first few years were... harrowing, especially the summer after April 2000 when the department was launched and there were only four months to develop the five integrated lecture-lab core courses, which are a distinctive feature of the B.S. program and represent the wave of 21st century BME curricula around the country. With help from many colleagues outside the department, all the core B.S. and M.S./Ph.D. courses were offered. Notable among those colleagues was Dr. Bruce KenKnight, who earned a Ph.D. in BME at UMN while employed at Guidant (now Boston Scientific CRM)—he created the two-semester senior design course, advised the first several groups, and remained involved every year since as an adjunct faculty member. The participation of other adjunct faculty members, Drs. Steve Salterman and Mark Kroll, in the senior design course has also been pivotal, and the 65 volunteers from local companies who have advised the senior design groups (Richard Stein, six times!) have been invaluable. Another key contributor was Arlene Bennett, the inaugural administrator for the department, who tirelessly worked to ensure everything got done.

While the first two faculty hires left the University, the department has since hired 11 more professors, all of who remain and constitute a tremendous cadre of young and promising assistant professors. In addition, Bin He relocated to UMN as a full professor, and through his leadership and pioneering research in neural imaging and brain-machine interfaces, he has established UMN as a world leader in neuroengineering, including a nucleus of faculty members in BME (Matt Johnson, Hugh Lim, and Tay Netoff) who participate in the Center for Neuroengineering, for which Bin He serves as Director. The two most recent faculty hires, Drs. Pat and Shannon Alford (currently postdocs at Harvard and MIT, respectively), represent

Continued inside
Vanessa Buie

Being a BME major and a Vikings Cheerleader is a rare combination, so we caught up with Vanessa between Vikings games and exams for some “half-time analysis” before her senior year.

Why did you choose BME as a major?
I chose BME as a major because of the options that it would provide me after graduation. As a senior in high school I knew I wanted to work in health care, potentially as a physician. However, I also knew that I may change my mind while in college. A family friend suggested BME because it provided the coursework for medical school but also prepared me to take a job in industry if I changed my mind.

How have you benefited from your research experience?
In my second year I was awarded an Undergraduate Research Opportunities Program (UROP) award to do research in Dr. Doris Taylor’s laboratory under post-doctoral fellow Matthew Robertson, working to develop a protocol to harvest and isolate cardiac progenitor cells. Cells were cultured and then analyzed using flow cytometry. The big takeaway from this experience was an appreciation for the trial and error process of research—from week to week the protocol evolved based on the latest results and more literature review.

What are your favorite extracurricular activities?
Since my freshman year I have been exposed to numerous clubs and activities. One that I devote a great deal of time to is Black Motivated Women, a student organization started here in 2006. The organization aims to bring together black women on campus through social and community activities. I have served as volunteer coordinator, President in my junior year, and treasurer this year. I really enjoy BMW because of the diverse backgrounds the ladies bring. Everyone is from a different place and has a different major, which results in a variety of perspectives during conversation. It’s really fun to learn from other people’s experiences.

What advice do you have for BME students who will graduate after you?
If you don’t understand something, ask. A lot of stress and headache can be avoided if you ask right away. And although it may seem like you’re the only person that doesn’t understand, I promise, there are at least 10 other people with the same question. Secondly, really try to learn and understand the concepts, not just how to get to the right answer. The courses in the major build on themselves, what you learn in the first half of the class is crucial to your understanding and success in the second half. For both cases, asking questions and understanding concepts, office hours work wonders. I did not start taking advantage of them until my junior year, but if you treat office hours like a normal class period, you will find yourself understanding more and succeeding more in your coursework.
Jim was granted his M.S. in Biomedical Engineering from the University of Minnesota in 1991. Robert Tranquillo, Ph.D. and William Hrushesky, M.D advised him in his graduate studies. The engineering/medical school partnership is what led Jim to pursue his Biomedical Engineering degree at UMN. He is currently the President at Penumbra, Inc., a privately held medical device company based in the San Francisco Bay Area.

**What are the key products of Penumbra?**
Penumbra is focused on developing products for the treatment of Neurovascular disease. The key product is the Penumbra Stroke System, currently in a clinical trial for the use in opening occluded vessels in the brain during an acute ischemic stroke. The product has been available since 2007 and is now a key therapy in the treatment of patients experiencing an acute stroke. We are in the process of developing a number of other products that we hope can solve some of clinical challenges in patients that have potentially debilitating neurovascular diseases.

**What were the key events leading to the formation of Penumbra?**
I have worked for 18 years in the Neurovascular area, and I immensely enjoy trying to solve the clinical and technical hurdles that remain in treating the brain. In the past few years, great progress had been made in using medical devices to treat hemorrhagic strokes. However, it was evident that the more prevalent ischemic stroke did not have any good treatment solutions. In 2004, a small team of us began work on trying to meet that unmet clinical need.

**How did your MS in BME influence your career path?**
The BME program at UMN offered a fantastic environment to directly work on medical devices in the clinical setting. I had an undergraduate degree in Biology and knew a combination of science and engineering would be important in making the correct applications of technical concepts to medical device design.

**Do you foresee any major changes in the nature of the medical device industry in the next decade?**
Biomedical engineers have a unique ability to influence the potential changes to the industry. Harnessing the innovation of engineers to focus on areas of increasing health care costs will be critical. The next generation of medical devices that will succeed will be focused on improving patient outcomes and ultimately lowering the cost of health care.

**What advice do you have for BME students aspiring to work in the medical device industry?**
During your education and training, get as much experience as you can applying your engineering skills to the clinical setting. Find ways to get experience in the hospital and clinical research labs to understand the clinical problems that need to be solved. The ability to work on devices to treat people is both a challenging and exhilarating career. Stay humble and work hard.

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**Anniversary, cont.**

areas of strategic interest to the department: soft tissue biomechanics/tissue growth and remodeling (Pat), and cancer cell metastasis/systems biology (Shannon). Given the high and still growing student interest in our degree programs, and the high research productivity of our faculty, the department anticipates additional hiring for many years to come.

Fortunately, the space allocated to the department in Nils Hasselmo Hall recently increased 200% to 22,000 ft² of assignable research space by acquiring the sixth floor. There is now sufficient space to house the entire department, a first for us and the perfect 10-year anniversary gift, as Hasselmo Hall is located at the intersection of the Medical School and the College of Science & Engineering and is one of the newest research buildings on campus designed for research in biomedical sciences and biomedical engineering. The news gets better, as the department is slated for allocation of another half floor of Hasselmo Hall in 2013, which will allow the department to grow to 20 faculty research groups. Additional space allocation then will also allow for the Institute for Engineering in Medicine and the Medical Devices Center, two key partners on campus for the department, to also be housed together with BME in Hasselmo Hall.

To celebrate our 10-year anniversary, a program was organized in conjunction with the annual BME Alumni Networking event during the Design of Medical Devices Conference in April. It featured remarks and reflections by Dean Crouch and Becky Bergman, Vice-President, Medtronic and Chair of the department’s Industrial Advisory Board for the first 10 years, and a presentation by 2004 bachelors alumna Katie (Gerbensky) Serrano, Commissioner’s Fellow, FDA, describing her internship in Equador in 2004. Katie was affiliated with the Equadorian National Program for HIV/AIDS and was tasked with developing a surveillance system for a subset of clinics and to lead a study comparing individual “perception of risk” to “true risk” for HIV/AIDS. Her photos of the Equadorian people and landscape reinforced her lessons learned: (1) develop an ability to do a lot with a little, (2) recognize the power of personal relationships, and (3) recognize the value of solidarity — good lessons for us all!
In recent years, neurotechnology has offered new hope for people with neurological disorders who have exhausted traditional medication-based therapies for their symptoms. For those individuals with Parkinson’s disease, essential tremor, and dystonia, many have elected to undergo deep brain stimulation (DBS) surgery in which thin electrodes are surgically implanted into regions of their brain that exhibit pathological activity related to their movement disorder. When these electrodes are paced with continuous pulses of stimulation, the therapy enables patients to once again reclaim control over their motor function.

Developing neuromodulation technology for these disorders is much like an auto mechanic trying to fix a noisy automobile; one must first diagnose where the noise originates and then develop a solution to correct the problem. Professor Johnson and his research team are investigating how ‘noise’ in certain brain structures results in the appearance of movement disorder symptoms and, in turn, how networks of neurons in the brain respond and adapt to neuromodulation with different degrees of therapeutic efficacy. These experiments are being performed through a combination of computational modeling, behavioral analysis, and electrophysiological recordings in patients with movement disorders and in animal models of disease.

These studies have shown that one can stimulate any one of several different brain regions and relieve motor symptoms. However, if the stimulation is not targeted correctly within a given nucleus or fiber pathway, little improvement in motor symptoms will result with stimulation. In such cases, the clinical benefit is often masked by the appearance of unwanted side effects (see figure). Professor Johnson and his team are developing new types of implants and stimulation strategies that are inspired by the neuroscience of disease with the goal of translating these technologies from animal models to the clinic.