



Department of Biomedical Engineering

*... to promote learning and discovery
that integrates engineering and life sciences
for the advancement of human health...*

Letter from the Chair



Dear Biomedical Engineering Alumni and Friends:

I am pleased to send our second newsletter from the Department of Biomedical Engineering at The Ohio State University.

Since I wrote last Spring, we have continued to grow into our new role as a Department. Our proposal for a new undergraduate major, with its central theme of *integrating* engineering and life sciences, continues in the review cycle that will take it over the next 6-18 months to the University Senate, to the Board of Trustees, and finally to the Board of Regents for final review and approval.

Following last year's planning for our undergraduate major, we have revised our graduate course offerings that emphasize the focus areas based on our research domains and the planned undergraduate teaching domains: Biomaterials; Biotransport and Biomechanics; Molecular, Cell, and Tissue Engineering; Bioimaging; and Biomedical Micro- and Nano-Technology. This planning has also allowed us to target the areas of expertise we seek with two faculty positions that we hope to fill this year: multi-scale modeling of physiological systems, and bioengineering of vision systems.

We are also nearing completion of renovations in Bevis Hall that were planned several years ago. In addition to new space for faculty offices, we have upgraded space for more research labs and for undergraduate teaching labs. Despite these improvements, we are actively seeking space to relocate the department to the main campus. Proximity to collaborators in the College of Medicine is a key factor that will shape our ability to achieve our mission of integrating engineering and life sciences at Ohio State.

In order to help us achieve our mission we will also continue to depend on help from our alumni and friends. As I wrote last year, there are many ways that you can help to fuel our successes. Most obvious is financial support that can be specifically targeted to the department. Gifts can help us achieve our strategic goals, and could include opportunities to endow a named professorship, a named scholarship, or laboratories and facilities. More modest gifts help with our

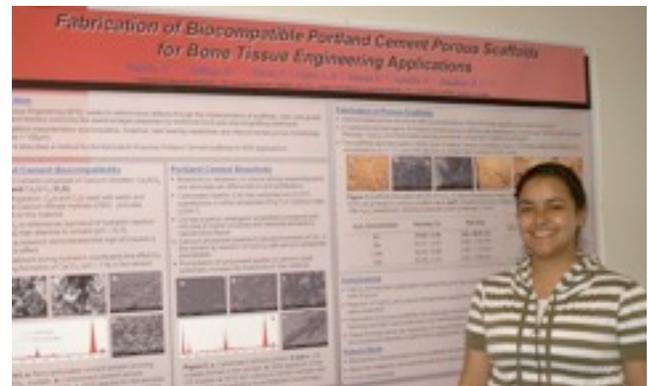
operations and events. In addition to financial support, I am hoping that the network of alumni and friends will be able to help our students find internship and employment opportunities.

In this newsletter, we continue to introduce our faculty members, describe an aspect of the innovative, collaborative research in the department, and list some recent student achievements. Additional information is available on our website: <http://www.bme.ohio-state.edu/>.

I continue to meet many new people on campus, and would especially like to meet our alumni and friends. Please stop by if convenient to get a firsthand look at our progress. Thank you, in advance, for your continuing support of our efforts.

Richard T. Hart, Ph.D.

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Winners of the Biomedical Engineering Year-End Academic Poster Session held June 1, 2007 included Natalia Higueta-Castro (pictured) and Mark Elias. Higueta's entry was titled *Fabrication of Biocompatible Portland Cement Porous Scaffolds for Bone Tissue Engineering Applications* and was co-authored by BME student, Daniel Gallego-Perez, and BME faculty, Derek Hansford. The event was organized by student planning committee, Becky Jansen, Theo Nicholson, and Ryan Pavlovicz.

MEET THE FACULTY



**Keith Gooch,
Ph.D.**
Associate Professor

What influenced you to become an engineer?

Growing up, my father was a mechanical engineer and my mother

was a medical assistant. Somehow it seemed natural that I should become a biomedical engineer. I liked chemistry a lot in high school but felt that it might be difficult to get a good job with a B.S. in chemistry so I studied chemical engineering instead. In college, the biological systems we studied in a biochemistry technical elective seemed much more interesting than distillation columns and heat exchanges we'd studied in my engineering classes, so when I went to grad school, I chose to work on a biologically oriented research problem.

Tell us about your research.

I am primarily interested in the factors that regulate the responses of cell and tissues to their environment. This is an extremely broad area with many researchers focusing on different biomolecular factors that stimulate and regulate these processes. My interest is somewhat different in that I am primarily interested in the role of other types of factors. For example, in collaboration with others, my laboratory is working to better understand how cells use mechanical forces to transmit information and to organize into tissues; how the aggregation of cells into spherical clusters stimulates differentiation of insulin producing beta cells; and how mechanical (e.g., blood flow and pressure) and chemical (e.g., oxygen concentration) factors regulate disease progression in vessels that have been used as bypass grafts.

Tell us a little about your life.

My hobby is marine biology, especially as related to coral reefs. Some people grow flowers in their front yards; I grow coral in my living room. There are many similarities between my laboratory's experimental work and my hobby. In both cases, it is important to replicate a complex environment to enable something to live and reproduce where it normally would not. In one case, it is cells in a Petri dish, in the other, it is coral in an aquarium.

What do you hope to bring to BME?

My goal is to establish a moderate-sized research group that has a disproportionately large impact on the field both by the discoveries we make and the long-term success of individuals after they leave the group. I look forward to helping to shape the Molecular, Cell, and Tissue Engineering tract in the new BME undergraduate curriculum.



**Derek Hansford,
Ph.D.**
Associate Professor

What influenced you to become an engineer?

I've always been someone who wanted to understand how things

work. Even growing up, I would question how trees got water to their leaves 80 feet in the air. As with most engineers I've met, I still enjoy figuring out how everything works, even if it means tearing apart a piece of equipment to find out.

What challenges have you faced in the field?

One of my biggest problems is settling on a particular problem and dedicating research to solving just that problem without being sidetracked. As a naturally curious person, it takes discipline to stay focused, so I've had to learn that. Also, since I was trained as a materials scientist and engineer, I've had to learn a lot of biology and biophysics outside of the classroom to be competitive in my field. But since most discoveries are made at the intersections of different fields, it really is worth the extra effort, and keeps things exciting.

Tell us about your research.

We explore the interaction of biological micro- and nano-structures (cells and biomolecules) with surfaces and engineered structures through micro- and nano-fabrication of diverse materials, and the development of new tools for microbiologists and surgeons. We have developed complete fabrication techniques for polymer microdevices and microstructures that we apply to measuring cellular forces, delivering targeted drugs into confined spaces within the

LEE WINS TEACHING AWARD

BME student Becky Jansen presented Stephen C. Lee, Associate Professor, with the 2007 Herman R. Weed Excellence in Teaching Award at the Biomedical Engineering Year-End Academic Poster Session on June 1, 2007. Bestowed annually to recognize excellence and innovation in the classroom, the award was established in 1997 and presented to Professor Weed himself to commemorate the Biomedical Engineering Center's anticipated transformation to academic department. Students chose Dr. Lee to be the "second-ever" recipient of the award, helping to mark the Department's long-awaited inaugural year. Congratulations Dr. Lee!



body, taking advantage of biological responses to microtopography for tissue engineering scaffolds, and developing diagnostic devices that either greatly improve resolution and diagnosis time or enable completely novel diagnostic techniques. We try to keep fabrication techniques as general as possible in terms of materials, so we can produce microfeatures out of most polymers (from water soluble or biodegradable to fluorinated piezoelectric polymers), slurries of small particle ceramics (from inert alumina to degradable hydroxyapatite), and composites of ceramics in polymer matrices. We are also looking at material processing techniques developed by Nature, such as templating the growth of nanomaterials by using peptide catalysts (similar to biomineralization).

Tell us a little about your life.

I grew up in Northeast Ohio in a small town with my parents both working as high school teachers. I have two brothers. We all grew up playing instruments (I play piano and could probably still play sax), so we were destined either to be musicians, engineers, or scientists. I like getting out and enjoying Nature. I take a lifelong approach to learning. Learning doesn't stop at the classroom door.

BME REACHES OUT TO COMMUNITY YOUTH



In June 2007, Assistant Professor, Yi Zhao, in collaboration with The Ohio State University Women in Engineering program, hosted a seminar in the Engineering in Motion workshop series. "Meeting with the Small: Biomedical Micro & Nanosystems" was presented to 34 ninth- and tenth-grade students from the Columbus community. The interactive seminar, designed to introduce fundamental engineering research skills to high school students, featured a classroom lecture on Micro-Electro-Mechanical-Systems (MEMS) and Nanotechnologies for Biomedical Applications and was followed by a hands-on laboratory session. Working in Dr. Zhao's lab, students were given a chance to fabricate polymeric microstructures and to characterize the structures using optical microscopy. Kudos to Dr. Zhao for providing the high schoolers with experiences they described as "remarkable", "entertaining", and "priceless".

BME ALUMNUS, FACULTY HAS DEEP ROOTS AT OHIO STATE

Cynthia Roberts, Professor of Ophthalmology and Biomedical Engineering and Martha G. and Milton Staub Chair for Research in Ophthalmology, has been a part of the Department of Biomedical Engineering (BME) since 1983, but her roots with Ohio State go much deeper than that. Dr. Roberts' father held the Zollinger Chair of Surgery -- the first endowed chair awarded at Ohio State -- from 1967 to 1972. She's a Buckeye alright.

Dr. Roberts' career path was to her own admission "a bit circuitous". She chose early on to pursue a career in nursing; her father thought this was "a good job" for her. After taking a job at the University of Iowa Hospitals, it became quickly apparent that nursing was not the right path for her. "I had tremendous problems separating myself emotionally from my patients," Dr. Roberts admits. "I saw my patients suffer through cancer... and participated in unsuccessful efforts, though intense, to save lives in a coronary critical care unit."

Intrigued by Biomedical Engineering and interested in building on what she already knew, she enrolled in undergraduate engineering classes and loved them. At last she could use her AP calculus credit! She spent two years taking undergraduate engineering courses, most of the time working from 3 p.m. to midnight as a nurse. "It was truly a schizophrenic existence" she quips.

By the mid-1980's, Biomedical Engineering was not well known in the medical community. Many physicians thought a biomedical engineer simply fixed equipment in the hospital. It was a challenge to establish herself as more than a "super-technician". Says Dr. Roberts, "I found that a good way to

encourage people to listen was by challenging their basic assumptions, and showing how a new perspective could make a difference in patient care." Dr. Roberts recalls fondly the time she was invited to give a presentation in Italy at a medical meeting that also involved live surgery for teaching purposes. Upon her arrival there, she discovered that she had been scheduled to perform live LASIK surgery on a satellite feed to 20 cities in 10 countries! "I had to tell the meeting organizer that I was not a surgeon," laughs Roberts. His expression of shock remains for Dr. Roberts memorable proof that she successfully had achieved the goal of communicating her ideas to physician colleagues.

Many have heard her infectious laughter echoing down the Bevis hallways. Few can find a more passionate advocate of BME, particularly when the conversation turns to her research, imaging applications in ophthalmology. Additional areas include laser-tissue interactions in refractive surgery and glaucoma, and more recently, ocular tissue response to intra-ocular pressure variations in glaucoma. "I have been fortunate to have good timing that allowed me to be on the leading edge of understanding fundamental relationships between corneal properties and response to surgery." The "most exciting" of her current projects is in the area of one of the world's leading causes of blindness. "We are pursuing new avenues of research that have not previously been explored to improve our understanding of structural influences on the development and severity of glaucoma," Dr. Roberts explains.

Her husband, Robert Small, M.D., is an electrical engineer and BME alumnus who had 10 years of experience in flight controls at Boeing before entering

medical school. He is now on the Ohio State faculty in Anesthesiology and advises BME students. One of her nieces is currently an undergraduate in pre-dental study, and another is a graduate student in molecular genetics here at Ohio State. Although those are the only two (of her 14 nieces and nephews) that she has been able to successfully indoctrinate into coming to Ohio State thus far, she anticipates more in the future.

Her pride in Ohio State is evident in all she does, and it can be traced back to her father. "My father started the first hospital-based helicopter rescue program in the country, and the new heliport on top of the hospital is dedicated to him... He chaired the committee that developed the very first paramedic manual, which was later adopted nationwide." He also served one year on active duty in Vietnam as Chief of Surgery in 1970.

"His vision was that the lessons of battlefield medicine would be transferred to saving civilian lives," says Dr. Roberts. "My hobby, and personal duty, is to compile the historical records, so the story is not lost."

How does she view her own legacy in BME after all these years? "I would like to inspire young faculty to explore research applications in vision," she says. "I hope to bring knowledge and experience to contribute to both the graduate and undergraduate programs in BME."



ACHIEVEMENT AND RECOGNITION

B. Rita Alevriadou, Associate Professor of BME and Internal Medicine was awarded a two-year \$409,500 NIH R21 grant starting on 1/1/08 entitled "Mechanoregulation of endothelial mitochondrial function".

Phil Barnes, David Holman, Mihaela Jekic, Jiachao Liang, Ryan Pavlovicz, and Jessica Sparks were invited to join the Phi Kappa Phi honorary. National guidelines allow for the selection of the top 10% of Graduate Students. Congratulations, BME students!

Charles I. Jones III (MS '05), Z. Han, T. Presley, G. Ilangoan and B.R. Alevriadou, "Endothelial cell respiration is affected by the oxygen tension during shear exposure", presented at the BME Society Annual Meeting, September 26-29, 2007 (Los Angeles, CA).



Cynthia J. Roberts, Professor of Ophthalmology and BME and participating BME faculty **Larry Leguire** presented at a Vision Research Scientific Forum featuring Prevent Blindness Ohio's 2007 Recipients of the Young Investigator Student Fellowship Award for Female Scholars in Vision Research, November 28, 2007 (Columbus, OH). Participating BME faculty, **Petra Schmalbrock**, Associate Professor of Radiology, presented the Keynote Address: "Bringing Research from the Lab Bench to the Public: A Challenge for Women in Science".

College of Engineering



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