

THE HENRY SAMUELI SCHOOL OF ENGINEERING

UNIVERSITY OF CALIFORNIA, IRVINE

DEPARTMENT OF BIOMEDICAL ENGINEERING



The Department of Biomedical Engineering (BME) at UC Irvine is looking forward to the beginning of a new academic year. We welcome back all students, and look forward to a successful year. I would like to take this opportunity to highlight several exciting events in BME, and encourage you to read more about our programs in the following pages.

With the support of \$5 million over three years from Edwards Lifesciences Corporation, The Henry Samueli School of Engineering is establishing The Edwards Lifesciences Center for Advanced Cardiovascular Technology. The new Edwards Lifesciences Center is the outgrowth of a longstanding relationship between the BME Department and Edwards Lifesciences, a global leader in the design of new technologies to treat cardiovascular disease, headquartered in Irvine. Housed on the second floor (approximately 13,000 assignable square footage) of a new building on campus, to be known as Engineering 3, which is due to be completed in fall 2009, the Edwards Lifesciences Center promises to bring together engineers, physicians, and other scientists to broadly address diagnostic, monitoring, and therapeutic problems in cardiovascular disease. The endowment will be used to support a director position, training fellowships, and to create an endowed fund to support the personnel and technology infrastructure of the Center. A national search for the founding director is underway, and we all look forward with great anticipation to the official opening of the Center in fall 2009.

BME currently has sixteen faculty, eight full-time staff, and more than 80 doctoral students and 400 undergraduate students. Faculty members serve as principle investigators on two P41 National Institutes of Health Center grants, and one of only 10 Defense Advanced Research Projects Agency (DARPA) funded centers in nanotechnology. This coming year, we will actively recruit new faculty to fill four open positions, including two at the assistant professor level, one at the associate professor level, and one for the new director of the Edwards Lifesciences Center.

This fall, BME is co-hosting the Annual Fall Meeting of the Biomedical Engineering Society with the University of Southern California and the University of California, Los Angeles. This national event will host more than 2,500 attendees, and presents an excellent opportunity to highlight our faculty and students. It will take place at the Renaissance Hollywood Hotel, Hollywood, Calif., from September 26-29, 2007.

Please take a few moments to learn more about the stories found in this issue, including our faculty profile featuring Dr. Andrew Putnam, a new recipient of a National Science Foundation Faculty Early Career Development (CAREER) Award and a National Heart, Lung and Blood Institute five-year grant; undergraduate and graduate program news; outstanding student highlights; and, upcoming BME events.

Best Regards,

Steven C. George, M.D., Ph.D.

William J. Link Professor and Chair

UCI RECEIVES \$5 MILLION FROM EDWARDS LIFESCIENCES TO ESTABLISH CARDIOVASCULAR TECHNOLOGY RESEARCH CENTER

Department of Biomedical Engineering partners with Edwards Lifesciences to drive cardiovascular innovation

UC Irvine's Henry Samueli School of Engineering has received a \$5 million gift from Edwards Lifesciences Corporation to establish a center focused on researching and developing the next generation of cardiovascular devices.

The Edwards Lifesciences Center for Advanced Cardiovascular Technology will promote interaction and collaboration among students, faculty members and experts by incorporating both undergraduate and graduate programs related to heart and vascular diseases. The programs will be directed by UCI's Department of Biomedical Engineering, and will involve a variety of other disciplines, including students from the Integrated Nanosystems Research Facility, the California Institute for Telecommunications and Information Technology, the Donald Bren School of Information and Computer Sciences, the Beckman Laser Institute, and UCI's Schools of Medicine, Physical Sciences, and Biological Sciences.

A national search is under way for a director, who will be charged with establishing a strategic plan and forming a leadership council to determine the center's specific direction.

"Our goal is to create an interdisciplinary facility that encourages students, faculty, researchers and visiting scholars to collaborate and exchange new ideas to drive the development of cardiovascular advancements and devices," said Steven C. George, M.D., Ph.D., William J. Link chair and professor of the

Department of Biomedical Engineering, who is spearheading the center's development. "The Edwards Lifesciences Center will thoroughly examine the integration of numerous disciplines, such as materials science, computer science, advanced imaging and microfabrication, or the manufacturing of devices with precision at levels much smaller than a millimeter, which all have the potential to lead to implantable devices that can help treat cardiovascular disease."

The center also will provide a training environment for hosting prominent experts in the field of cardiovascular technology. It will be located in Engineering 3, a new building on the UCI campus scheduled for completion in August 2009.

"We are pleased to closely collaborate with Edwards Lifesciences, an international leader in cardiovascular technology, to develop a center that combines exceptional faculty, resources and tools to advance this evolving field," said Nicolaos G. Alexopoulos, Ph.D., dean of The Henry Samueli School of Engineering. "UC Irvine is located in one of the largest medical device company clusters in the world, which I believe uniquely positions us to address this critical health care area and initiate a world class center."

Irvine-based Edwards Lifesciences, which develops products and technologies to treat advanced cardiovascular disease, is granting the multiyear gift through the Edwards Lifesciences Fund. The fund was established to support advancements in knowledge and improvements in quality of life to help those affected by cardiovascular disease, particularly in the communities where the company's employees live and work.

"We are proud to partner with a neighbor that is as accomplished and committed to excellence as UC Irvine to establish a center devoted to transformational cardiovascular technology research," said Michael A. Mussallem, Edwards Lifesciences' chairman and CEO. "This grant is a testament to our dedication to providing innovative solutions for people fighting cardiovascular disease, as well as our commitment to strengthening the communities in which we live and work."



Proposed design of the future Engineering 3 building

FACULTY

ASSISTANT PROFESSOR ANDREW PUTNAM AWARDED PRESTIGIOUS NSF AND NIH GRANTS

Resources to enable further study of tissue engineering and capillary vessel growth



Andrew Putnam, Ph.D., assistant professor of biomedical engineering and chemical engineering and materials science at the University of California, Irvine, has been honored by the National Science Foundation with a Faculty Early Career Development (CAREER) Award and a \$400,000 grant. Putnam was recognized for his research with tissue engineering and capillary bed

growth, specifically, “Defining the Biomechanical Role of the Extracellular Matrix in Capillary Morphogenesis: An Interdisciplinary Plan Integrating Research and Education.”

The National Heart, Lung and Blood Institute, affiliated with the National Institutes of Health (NIH), has also given Putnam a \$1.4 million grant over five years for his project, “Regulation and Enhancement of Angiogenesis in Dense Fibrin Matrices.” The research area is similar to the NSF Career Award (angiogenesis/capillary morphogenesis); however the NIH grant will give his research group the opportunity to explore the use of adult bone marrow-derived stem cells to facilitate capillary growth both in vitro and in vivo in a mouse model.

Putnam’s laboratory, Cell Signaling in Engineered Tissues (CSET), focuses on the extracellular matrix (ECM), a complex composite of proteins and polysaccharides that constitutes all of the noncellular components of tissues in the human body.

The CSET lab’s research focuses on the global hypothesis asserting that expanding on the fundamental understanding of the interactions between cells and the ECM is essential to designing instructive materials that can direct cell function in engineered tissues.

“In tissue engineering, clinical success has been achieved in thin tissues, like skin, or avascular tissues, like cartilage, because diffusion of oxygen and other nutrients is sufficient to sustain the cells in these tissues” Putnam said. “With larger, more complex tissues, capillary vessels are needed to distribute nutrients. Engineering these vessels remains the most significant challenge in our field, one that our lab hopes to address by understanding the ECM’s role in capillary development.”

Better understanding the ECM’s function could have important implications in treating diseases in which capillary growth is improperly regulated, such as cancer, and may have potential impacts on efforts to engineer many different tissues, including bone and cardiac muscle.

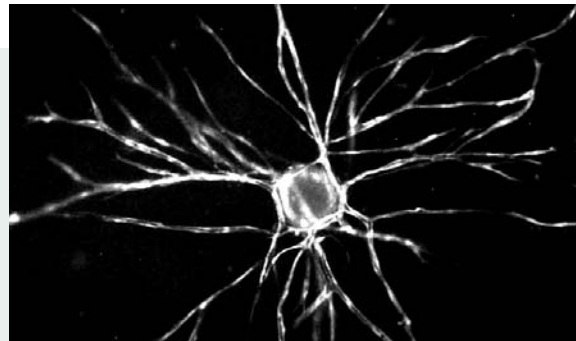


Figure 1: Human endothelial cells expressing green fluorescent protein radiate from a microcarrier bead to form capillary-like structures in a 3-D hydrogel matrix. (Scale bar = 250 microns)

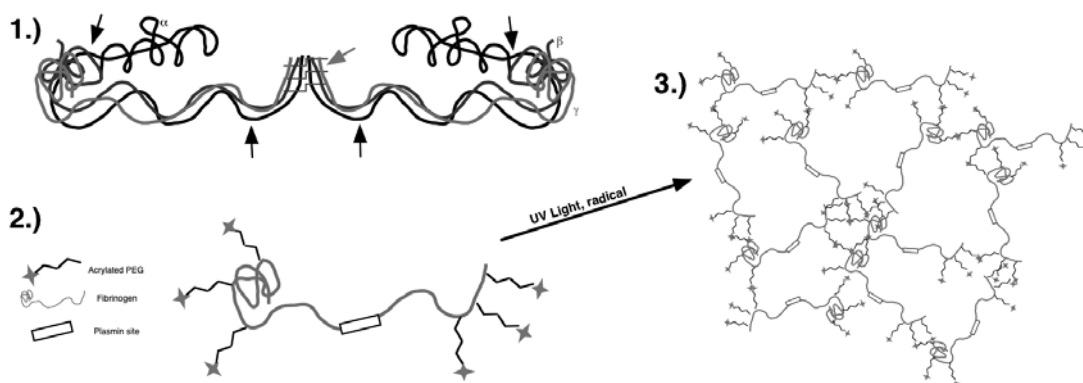


Figure 2: The funded studies will explore capillary morphogenesis in a new PEGylated fibrinogen biomaterial pictured here. (1.) Fibrinogen is dissociated into its representative alpha, beta, and gamma chains, and then (2.) PEGylated at specific cysteine residues. (3.) Acrylated end groups on PEG are then linked to form a hydrogel network via UV photopolymerization.

GRADUATE PROGRAM NEWS

The BME Department extends a warm welcome to the class of 2007, the largest incoming class to date with 22 Ph.D. students and 12 master's degree students. Despite fierce competition from top biomedical engineering programs around the nation, UC Irvine's incoming BME graduate students boast strong academic and research records. A recruitment visitation day was held on March 2, where 23 prospective students visited the UC Irvine campus and explored state-of-the-art laboratories and facilities, as well as a variety of exciting projects.

BME is also proud to announce that third-year BME graduate student Chris Raub received the prestigious Ruth L. Kirschstein National Research Service Award (NRSA) for Predoctoral Fellows from the National Institutes of Health. Third-year graduate student Kanaka Hettiarachchi won the best presentation award at the University of California Bioengineering Symposium held in San Francisco on June 15-17.

To kick-off the summer, the Biomedical Engineering Society student chapter held its first-ever softball game with faculty and students, where they demonstrated their understanding of bio-mechanics in a fun-filled afternoon in early July. A second game is scheduled for Oct. 20 during the first BME faculty-student retreat, to be held at the Bahia Hotel in San Diego.

BME would also like to congratulate recent graduates who are now working in academia or industry: Lisen Wang, a postdoctoral researcher at UC Berkeley; Jeremy Emken and Anne Taylor, postdoctoral researchers at the California Institute of Technology; Alan Lee, a postdoctoral researcher at Stanford; and Wajeeh Saadi, who is working at a biotechnology start-up company in Boston, Mass.

UNDERGRADUATE PROGRAM NEWS

BME's undergraduate program celebrated its third graduating class at commencement ceremonies on June 15, 2007. This past academic year, 58 BME and 44 BME: Premedical majors successfully completed the program. A luncheon hosted by the Department, honoring 13 honors students, was held following commencement.

BME is proud of its undergraduates as they continue to be recognized for their academic achievements. In 2006-07, eight students received scholarships and for 2007-08, nine will be receiving scholarships.

BME Professor Frithjof Kruggel, M.D., will spearhead the formation of a new undergraduate specialization in bioimaging, starting in fall 2008. The development of new image acquisition methods and tools for image reconstruction and analysis is an important and growing area in biomedical engineering, and the curriculum will include lectures on bioimaging devices, signal and image processing, biomedical visualization, and a lab course in biocomputation. This will mark BME's second specialization, joining biophotonics.

OUTSTANDING STUDENT HIGHLIGHTS

Jeff Carroll

Carroll has published a paper titled, "Fundamental Frequency Discrimination and Speech Perception in Noise in Cochlear Implant Simulations," in *Hearing Research*, vol. 231, Sept. 2007, pages 42-53, and in July presented at the Conference on Implantable Auditory Prostheses (CIAP) in Lake Tahoe, Calif. He is also a co-inventor on an upcoming patent application for a sound generation device used to suppress tinnitus.

Ivan Chang

Chang has been working on a systems biology project with the research group of Douglas C. Wallace, Ph.D., professor of pediatrics and biological chemistry, and Pierre Baldi, Ph.D., professor of information and computer sciences and biomedical engineering. He has developed a detailed computer model of mitochondria and energy production in living cells, which is playing an essential role in helping to understand the production of oxidative radical species that are involved in aging, DNA damage, cancer, and other diseases. A better quantitative understanding of radical species will likely lead to new medicines and therapeutic approaches.

Tadashi Kaneko

Kaneko organized a group of five faculty and students to compete in the 2007 Stradling Yocca Carlson and Rauth Business Plan Competition. The proposed business, Bone-Rad Therapeutics, Inc. (www.bone-rad.com), would develop and market radioactive bone cement as a "revolutionary treatment paradigm for tumors in bone." The Bone-Rad team placed first in the competition, winning \$15,000 and the opportunity to present the business plan to the Tech Coast Angels investing group. Bone-Rad Therapeutics, Inc., has now been officially incorporated and is working toward bringing radioactive bone cement to the consumer market.

Chang Won Lee

Lee's paper, "An Efficient Algorithm for Current Source Localization with Tetrodes," co-authored with Hieu Dang and Zoran Nenadic, Ph.D., assistant professor of biomedical engineering, was accepted as one of only 12 open finalists at the 29th Annual International Conference of the Institute of Electrical and Electronics Engineering (IEEE) Engineering in Medicine and Biology Society in Lyon, France, Aug. 26-29, 2007.

Amaan Mazhar

Mazhar has shown exceptional leadership skills in the laboratory of Bruce Tromberg, Ph.D., professor of biomedical engineering and director of the Beckman Laser Institute and Medical Clinic at UC Irvine. He is currently president of the UC Irvine graduate student chapter of the Biomedical Engineering Society and has taken the lead on various aspects of a recent multi-million dollar National Institutes of Health grant writing effort. His research involves the engineering of a non-invasive, wide-field optical imaging technology, known as modulated imaging, with applications in image-guided surgery.

Continued

Upcoming Events

2007-08

OUTSTANDING STUDENT HIGHLIGHTS *(continued)*

Christopher Raub

Raub, a Ph.D. student in Chair and Professor Steven George's Pulmonary Transport and Tissue Remodeling Laboratory, was awarded a two-year Ruth L. Kirschstein National Research Service Award (NRSA) for Predoctoral Fellows, valued at nearly \$60,000. He currently researches the development of multiphoton microscopy, a laser imaging technique which collects structural and biochemical information without damaging tissue. This form of microscopy is a potential clinical tool for diagnosing and monitoring scar tissue formation and subsequent changes to the mechanical properties of airways in patients with asthma. The fellowship will extend his current research, using laboratory-built tissues, to a rabbit model of airway scarring.

Allison Zemek

Zemek, a junior undergraduate student, was named a 2007 Barry M. Goldwater Scholar Engineer. Established by Congress in 1986, Barry M. Goldwater Scholarships support study in the fields of mathematics, engineering and the natural sciences as preparation for careers in these areas.

BME PROFESSOR AND BECKMAN LASER INSTITUTE CO-FOUNDER PUBLISHES NEW BOOK



In 2007, Academic Press/Elsevier published in its prestigious Methods in Cell Biology series, "Laser Manipulation of Cells and Tissue," edited by Beckman Laser Institute Co-Founder Michael W. Berns, Ph.D., professor of biomedical engineering, and Professor Karl Otto Greulich, Ph.D., of the Leibniz Institute for Age Research, Jena,

Germany. This 750-page text is comprised of 27 chapters by experts from the U.S., Japan, Germany, Sweden, Austria, Israel, Australia, India, and Czechoslovakia. Many of the chapters focus on work inspired by research from Berns' nearly 40-year career. Also, this book provides a verbatim reproduction of Berns' landmark paper published in *Science* magazine in 1981, which established the vision for laser cell surgery. This book emphasizes the past and current impact of Berns' work, especially in shaping the field of laser microbeam irradiation, and includes such subjects as laser scissors (ablation), laser tweezers, and laser catapulting.

The Second Laboratory for Fluorescence Dynamics Workshop in Advanced Fluorescence Imaging and Dynamics

Laboratory for Fluorescence Dynamics
UC Irvine Department of Biomedical Engineering
Sponsored by Carl Zeiss Inc., the University of California, Irvine, and Globals Software for Spectroscopy and Images
Oct. 22 - 26, 2007

For more information, please visit
<http://www.lfd.uci.edu/workshop/>

"Optically-Based Biomedical Sensing Approaches"

BME Distinguished Lecturer Series

Gerard Cote, Ph.D.

Charles H. and Bettye Barclay Professor and Department Head, Biomedical Engineering
Texas A&M University

Oct. 26, 2007, 4 - 5 p.m.

Location: Natural Sciences II, Room 3201

"Biomedical Engineering Design and Global Health"

BME Distinguished Lecturer Series

Matthew Glucksberg, Ph.D.

Professor and Chairperson, Biomedical Engineering
Northwestern University

Nov. 9, 2007, 4 - 5 p.m.

Location: Natural Sciences II, Room 3201

OCTANe Second Annual California Medical Device Forum

Westin South Coast Plaza

686 Anton Blvd.

Costa Mesa, CA 92626

Nov. 15, 2007, 7 a.m. - 8 p.m.

For more information, please visit
<http://www.octaneoc.org>

"Thermodynamics and Beyond: Connecting Modeling with Outcome in Cryobiology"

BME Distinguished Lecturer Series

John Bischoff, Ph.D.

Distinguished McKnight University Professor
University of Minnesota

Dec. 13, 2007, 4 - 5 p.m.

Location: Natural Sciences II, Room 3201

For more information, please visit
www.bme.uci.edu
or call 949.824.6284



BME Discovery

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