Upcoming Events 2006–07

Digital and Phase Contrast Mammography
BME Seminar
Featuring Hong Liu, University of Oklahoma
Oct. 19, 2006, noon – 1 p.m.
Location: 3201 Natural Sciences II

What are the Cellular and Molecular Role Players in Arteriolar Adaptation? In Vivo and Computational Systems Approaches
BME Distinguished Lecturer Series
Featuring Dr. Tomas Skalak, University of Virginia
Nov. 2, 2006, noon - 1p.m.
Location: McDonnell Douglas Engineering Auditorium

Cells-on-Chips for Biomedical Applications
BME Distinguished Lecturer Series
Featuring Dr. Mehmet Toner, Harvard Medical School, Surgery – Massachusetts General Hospital
Nov. 16, 2006, noon - 1p.m.
Location: McDonnell Douglas Engineering Auditorium

Bronchoconstriction in Asthma: An Integrated System Response Beyond the Summed Behavior of Individual Airways
BME Distinguished Lecturer Series
Featuring Dr. Jose Gabriel Venegas, Harvard Medical School, Anesthesia - Massachusetts General Hospital
Nov. 30, 2006, noon – 1 p.m.
Location: McDonnell Douglas Engineering Auditorium

Skeletal Tissue Engineering
BME Distinguished Lecturer Series
Featuring Dr. Michael T. Longaker, Stanford University
Jan. 18, 2007, noon - 1 p.m.
Location: McDonnell Douglas Engineering Auditorium

Brain on a Chip: Engineering Form and Function in Cultured Neuronal Networks
BME Distinguished Lecturer Series
Featuring Dr. Bruce Wheeler, University of Illinois, Urbana-Champaign
Jan. 25, 2007, noon – 1 p.m.
Location: McDonnell Douglas Engineering Auditorium

Systems Approaches to Robust Analysis of Circadian Oscillators
BME Distinguished Lecturer Series
Featuring Dr. Frank Doyle, University of California, Santa Barbara
March 8, 2007, noon – 1 p.m.
Location: McDonnell Douglas Engineering Auditorium

Engineering and Clinical Implementation of a Dedicated Breast CT Scanner
BME Distinguished Lecturer Series
Featuring Dr. John M. Boone, University of California, Davis
April 19, 2007, noon – 1 p.m.
Location: McDonnell Douglas Engineering Auditorium

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

BME Discovery

University of California, Irvine
The Henry Samueli School of Engineering
Department of Biomedical Engineering
3120 Natural Sciences II
Irvine, CA 92697-2715

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BME Discovery

FALL 06

THE HENRY SAMUELI SCHOOL OF ENGINEERING
UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF BIOMEDICAL ENGINEERING

Dear Friends,

I am pleased to return from my year sabbatical spent in Italy with my family, and would like to express special thanks to Professor William Tang who served as the interim chair during my absence. Professor Tang did a remarkable job moving our programs forward, and we are indebted to his efforts – the research and training programs of the Department are developing with tremendous energy, and I would like to take this opportunity to highlight just a few recent and future activities.

The Department has settled into the first new and contiguous space in Natural Sciences II. With more than 17,000 square feet allotted for research and administration, this building features an open lab, designed to stimulate the exchange of ideas across faculty laboratories. Biomedical engineering celebrated the official opening in June.

This year, we plan to recruit two faculty members in the area of neuroengineering, with particular interest in new imaging modalities, computational algorithms, the brain-computer interface, and neural stem cells. These two new members will complete our initial cluster of faculty in this specialized area.

Our undergraduate and graduate programs continue to attract top talent from California and across the nation. Our incoming freshman undergraduate class is the largest major in The Henry Samueli School of Engineering, and the fourth largest major on campus, maintaining the utmost quality. Our incoming first-year graduate students, which total 18 doctoral candidates and 13 master's students, also demonstrate the highest average test scores and grades to date.

I invite you to take a few moments to read about our Department's research activities, faculty and student accomplishments, including our faculty profile on Professor Abraham Lee, and upcoming events. For additional information, please visit our website at www.bme.uci.edu.

Best Regards,
Steven George
William J. Link Professor and Chair

FACULTY

Professor Abraham Lee's Advancements in Microfluidics Research Published

Lee's findings highlighted in popular publications

Abraham Lee, professor of biomedical engineering, together with his research group, was recently published in several prominent peer journals and magazines, including the *Journal of the American Chemical Society, Analytical Chemistry, Lab on a Chip,* and *Chemical Science,* for research and advancements made with a relatively new branch of microfluidics that utilize droplet emulsions as reactors for therapeutic encapsulations and high throughput biochemical assays.

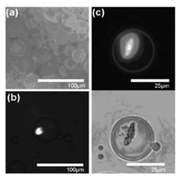
The *Journal of the American Chemical Society* (JACS, 2006, 128, 5656 - 5658) article highlights Lee's exploration of new ways to package materials such as beads, proteins, and cells inside lipid vesicles by utilizing a novel microfluidic device. Applications of this technology are numerous, and include cell-based assays, cell-based therapies, protein drugs, and the development of artificial cells. This research was also published in *Analytical Chemistry* in an article titled, "Vesicle making goes microfluidic," as well as in a *Lab on a Chip* journal article called, "Encapsulation of cells, proteins, and microbeads."

Lab on a Chip (Lab Chip, 2006, 6, 174 – 178) published Lee's research findings, in which he and his co-authors addressed a novel microfluidic system capable of measuring, mixing, and reacting starting materials before the collection and analysis of products, all integrated in one place. The mixing ratio and concentration control of the system by synthesizing semiconductor nanoparticles was also demonstrated in this paper. Particles were shown to have regular particle sizes, noting a further advantage over bulk mixing.

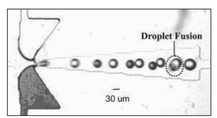
Lee's group also showed the synthesis of biodegradable nanoparticles (e.g. PLGA) using this method. The device is a step towards producing a micro total analysis system that can perform all operations normally completed in a laboratory, including synthesis, processing, purification, and analysis on one microfluidic device efficiently and economically by using minute amounts of solvents and reagents. These findings were also highlighted in the Royal Society of Chemistry's *Chemical Science* magazine in an article titled, "Reaction system that measures, mixes and reacts."

Lee's focal research interests include the development of integrated micro and nano fluidic chip processors for diagnostic and therapeutic applications. These chip processors are designed for the precise manipulation of biological components (e.g. cells, proteins, nucleic acids, and lipids), reagents, and synthesized nanoscale probes. Targeted applications include biosensors to detect environmental and terrorism threats, point-of-care diagnostics, "smart" nanomedicine for early detection and treatment, automated cell-sorting based on electrical signatures, tissue engineering and stem cells, and the synthesis of ultra-pure materials.

Lee is an American Institute for Medical and Biological Engineering Fellow, an international advisory editorial board member of *Lab on a Chip*, and currently serves as a subject editor for the *Journal of Microelectromechanical Systems*. He also has 32 issued patents, and has published more than 50 peer-reviewed papers in journals and conferences.



Fluorescence microscopy images of (a) GFP and (b) a cervical cancer cell encapsulated in vesicles. (c) Fluorescent microscopy and (d) light microscopy images of a breast cancer cell packaged in a vesicle



To view Lee's recently published research visit:

Analytical Chemistry
http://biomint.eng.uci.edu/images/0706material.pdf

Lab on a Chip
http://www.rsc.org/ej/LC/2006/b607679n.pdf

Chemical Science
http://www.rsc.org/Publishing/ChemScience/Volume/2006/03/reaction_system.asp

GRADUATE PROGRAM

Biomedical Engineering Welcomes New Graduate Students

The Department of Biomedical Engineering is excited to welcome the fall 2006 class of incoming graduate students, which includes 18 Ph.D. candidates and 13 master's students. These students are outstanding in all aspects of the Department's standards - including grade point average, test scores, research experiences, and so forth - and received competitive offers from top programs across the nation. An orientation took place on Sept. 20 that included "fair-like" faculty research booths to help students select their first quarter labs in which to rotate. This last spring, the Department was also proud to hood five Ph.D. degrees and 15 M.S. degrees. This brings the total number of Ph.D. degrees awarded to nine and M.S. degrees to 31.

In an effort to continuously improve our Ph.D. program, the 2005 class will be the first group expected to fulfill a new requirement - two additional "depth" graduate courses - in the upcoming second year, in order to take the qualifying exam by summer 2007. Almost all doctoral students that passed the preliminary exam were matched with BME faculty research advisors.

During the 2005-06 academic year, three Ph.D. students were awarded fellowships. Two received the Achievement Rewards for College Scientists Fellowship and another was the first UC Irvine graduate student to receive the United Negro College Fund Merck Science Initiative Dissertation Fellowship.

As the Department prepares for the new academic year, the Biomedical Engineering Society graduate student chapter has new leadership in place and several events already planned for the year. In the past, the BMES group has been instrumental in welcoming the incoming class, and this tradition will continue in 2006-07.

UNDERGRADUATE PROGRAM

A Growing Undergraduate Class

The biomedical engineering undergraduate program continues its steady growth of students, much in part due to the increasing interest in the biomedical engineering pre-med program. This year, the Department had the largest number of high school applications in The Henry Samueli School of Engineering. There were 1,116 BME pre-med majors and 346 BME majors. Of those applicants, 51 biomedical engineering majors were offered admission, 41 of which were freshman and 10 were transfer students. One hundred and twenty-two biomedical engineering pre-med majors were also offered admission, 115 of which were freshmen and seven were transfer students.

With the continual growth of innovative research and expert faculty of the biomedical engineering program, the Department hopes to continue to attract some of the brightest and most qualified students in the nation.

IM-SURE of Summer 2006

This past summer, two biomedical engineering undergraduate students, Minh Guong Nguyen and Shehreen Dheda, received National Science Foundation summer research fellowships to participate in the Integrated Micro/Nano Summer Undergraduate Research Experience. They joined 20 other IM-SURE undergraduate students from across the nation to spend 10 weeks in different UC Irvine faculty laboratories, gaining first-hand research experience on projects ranging from the fabrication and characterization of nanostructure, to the development of biosensors.

Nguyen and Dheda were two of the 22 students chosen from 174 applicants to participate in the program, which offered seminars that allowed for faculty mentors to introduce and explain their individual fields of study and how their different disciplines related to others.

"By interacting with others on a professional and social level, I have improved the effectiveness of my communication, problem solving, and leadership skills, and had a chance to learn to talk and work with others as an equal team member," Nguyen said.

The students also had the opportunity to present their projects at a symposium held at the end of the summer. Under the guidance of Professor Abraham Lee, Dheda worked on a project developing a microfluidics-based synthetic tactile sensor array to be embedded within the artificial skin of a prosthetic hand.

"The experience I gained and the knowledge that I have obtained by taking part in this project has allowed me to understand the field of microfluidics in further depth. The IM-SURE program is a meaningful experience for students to learn more about the interdisciplinary nature of the micro and nanotechnology industries," Dheda added.

Nguyen said she also found that the IM-SURE program provided her with valuable knowledge she will use to work towards her future goals.

OUTSTANDING GRADUATE STUDENT PROFILES

David Cuccia, a Ph.D. candidate, is working on his thesis focused on modulated imaging technology, under the supervision of his advisor, Bruce Tromberg, professor of biomedical engineering and director of the Laser Microbeam and Medical Program at the Beckman Laser Institute.

Modulated imaging technology is a fast, non-contact, scan-free method that enables one to image and quantify the optical properties of a tissue over a large area. The technology can simultaneously map surface and sub-surface tissue structure, function and composition, and can also determine scattering and absorption properties, as well as perform surface profiling in a single measurement. Applications include medical diagnostics, computer rendering and animation, and pharmaceutical quality control and process monitoring.

Cuccia recently presented the technology titled, "Modulated Imaging: Quantitative Imaging of Intrinsic and Extrinsic Tissue Optical Properties and Chromophores in the Spatial Frequency Domain," at the Lasers in Medicine and Biology Gordon Conference held in July at the Holderness School in Holderness, N.H. Upon graduation, Cuccia will become chief technology officer of Modulated Imaging Corp., a UC Irvine-based start-up company aimed at commercializing modulated imaging technology.

Nzola De Magalhães is currently a Ph.D. candidate working in Assistant Professor Vittorio Cristini's lab with an emphasis in biocomputational modeling. She is one of 12 graduate students, and the first UC Irvine graduate student, nationwide to receive the prestigious UNCF-Merck Science Initiative Dissertation Fellowship this year. Since 1995, the UNCF-Merck Science initiative has been a joint effort by the Merck Company Foundation, the Merck Research Laboratories and the United Negro College Fund to enhance the potential of talented young African American scientists pursuing degrees and careers in biomedical research fields. Each year, top applicants are chosen for their academic achievements and potential in biomedical research in a nationwide competition.

As a Merck Fellow, De Magalhães will receive financial and institutional support for up to two years. In addition, she will be mentored by a Merck research scientist, and have the opportunity to conduct collaborative research at Merck Research Laboratories. The Merck fellowship will fund De Magalhães' research project focused on "integrative experimental and computational studies of tumor microvasculature." She will incorporate a multi-scale virtual cancer simulator developed by Cristini's group, to investigate and predict quantitatively the spatio-temporal distribution of tumor microvasculature in *in-vivo* tumor models.

Cyrus Ghajar was recently named the Arnold and Mabel Beckman Scholar after receiving a scholarship from the Achievement Rewards for College Scientists Foundation last year. His research under Steven George, professor and chair of the biomedical engineering department, and Andrew Putnam, assistant professor of biomedical engineering and chemical engineering and materials science, is focused on how two invasive processes - blood vessel network formation and tumor growth - are affected by the density of the surrounding extracellular matrix and by other cells normally present in the interstitium (e.g. mesenchymal stem cells and fibroblasts). His first paper will appear in the October issue of *Tissue Engineering*.

Lindsey VanSchoiack, a fourth-year biomedical engineering graduate student, originally from Washington State, received an Achievement Rewards for College Scientists Foundation award for a second year. VanSchoiack's research focuses on chemical and mechanical factors in wound healing – specifically looking at the quality of integration between bone and metal implants. With the help of her advisor, James Earthman, professor of chemical engineering and materials science and biomedical engineering, VanSchoiack has conducted experiments that monitor the osseointegration of titanium implants in the femur of rats with and without the inhibition of matrix metalloproteinase expression.